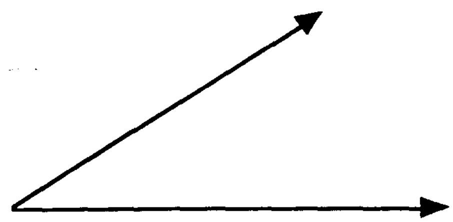
Name ____________________

All About Angles - Review

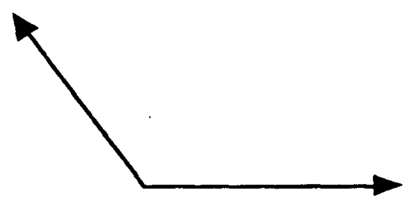
Use a protractor to measure the given angle. Draw a complementary angle. Label each angle with its measurement in degrees.

1.



Use a protractor to measure the given angle. Draw a supplementary angle. Label each angle with its measurement in degrees.

2.



Find the complement of each angle measure.

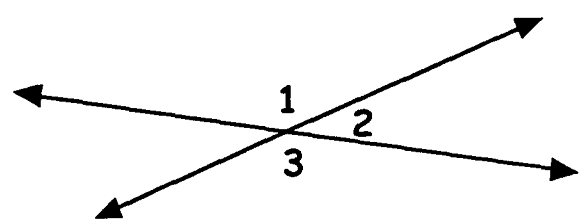
3) 22° _____ 4) 84° _____ 5) 18° _____

Find the supplement of each angle measure.

6) 15° _____ 7) 110° _____ 8) 153° _____

Use the diagram to find each angle measure.

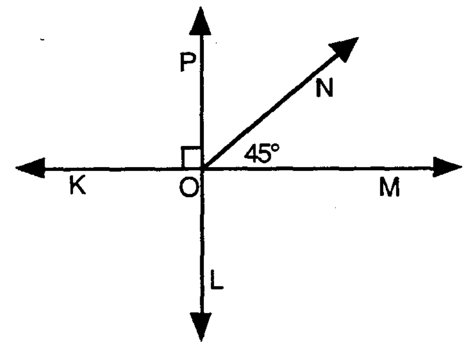
9) < 1 = _____
10) < 2 = _____
11) < 3 = _____



12) Draw a set of vertical angles. Use a protractor to measure each angle. Label each angle with its measure in degrees.

All About Angles- Review

Use the figure to answer the questions.



1) Name two complementary angles.

_______ and _______

2) Name two adjacent acute angles.

_______ and _______

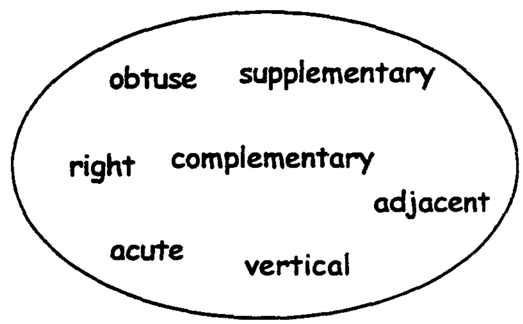
3) Name two vertical angles.

_______ and _______

4) Name two supplementary angles.

_______ and _______

Use the figure and word bank to answer the questions.



1) < TOS is an ____________ angle.

2) _________ is a right angle.

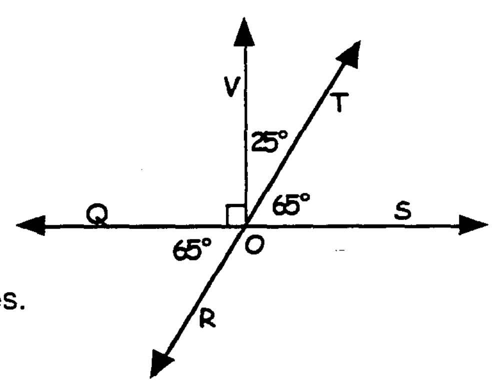
3) <QOT and < TOS are _____________ angles.

4) The measure of < ROS = _________________.

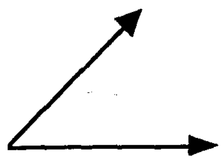
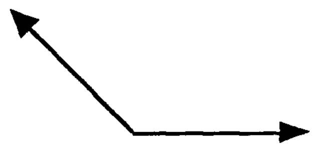
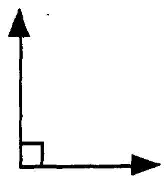
5) _______ and ________ are vertical angles.

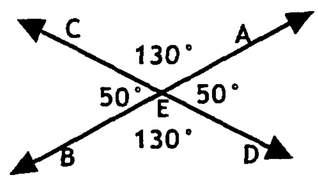
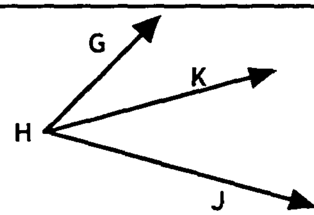
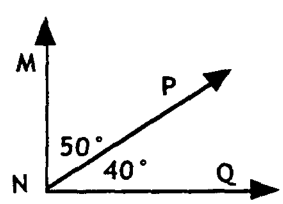
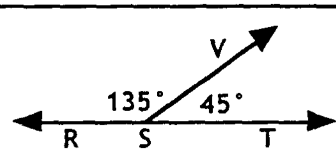
6) ________ and _______ are complementary angles.

7) <SOR is _____________ to < QOR.



Review of Angles and Angle Pairs

Acute Angle	Obtuse Angle	Right Angle
 An **acute** angle is greater than 0° and less 90°.	 An **obtuse** angle is greater than 90° and less than 180°.	 A right angle is 90°.

NAME	FIGURE	THINK
Vertical Angles		$\angle CEA \cong \angle BED$ $\angle CEB \cong \angle AED$
Adjacent Angles		$\angle GHK$ is adjacent to $\angle KHJ$
Complementary Angles		$\angle MNP + \angle PNQ = 90°$ <MNP and <PNQ are complementary angles. $\angle MNQ = 90°$
Supplementary Angles		$\angle RSV + \angle VST = 180°$ <RSV and <VST are supplementary angles. $\angle RST = 180°$

Name ________________

Vocabulary Challenge
Angle Analogies

Part 1. Complete each comparison. Make sure that the relationship between the second pair is the same relationship shown by the first pair.

1) acute : obtuse	as	less than 90° : ____________	
2) complementary : 90°	as	______________	: 180°
3) 145° : obtuse	as	40° : ________________	
4) next to : adjacent	as	across from : ______________	
5) more than 90° : obtuse	as	_________________	: acute

Part 2. On your own. Try to make up an analogy of your own using math vocabulary.

Name ____________________

Vocabulary Practice
Angles

Fill in the boxes in the following chart. For the box that says "phrases," write a few words that describe or define the vocabulary term. Think of as many ways as you can to explain the meaning of the vocabulary word. In the box that says "illustrations," draw a picture or pictures that represent the meaning of the term.

Vocabulary Term	Phrases	Illustrations
Right Angle	• measures exactly 90° • has a right angle symbol	
Obtuse Angle		
Acute Angle		
Straight Angle		
Complementary Angles		
Supplementary Angles		
Vertical Angles		
Adjacent Angles		

Answer Key
Obj. 47

Complementary and Supplementary Angles

Find the measure of the complementary angle:

1) 45°   2) 65°   3) 20°   4) 38°

Find the measure of the supplementary angle:

1) 160°   2) 95°   3) 60°   4) 40°

page 2. Find the complement

1) 60°   2) 72°   3) 10°   4) 86°   5) 15°   6) 66°

Find the supplement

1) 130°   2) 99°   3) 15°   4) 74°   5) 165°   6) 90°

More Practice with Complementary & Supplementary Angles

1) T   2) T   3) F   4) F   5) F   6) T   7) T   8) F

Measure the Angles

1) 37°
c 53°
s 143°

2) 150°
c (none -angle is greater than 90°)
s 30°

3) 14°
c 76°
s 166°

Vertical Angles Transparency

Intersecting lines #1
angle 1 = 150°
angle 2 = 30°
angle 3 = 150°
angle 4 = 30°

Intersecting lines #2
angle 1 = 70°
angle 2 = 110°
angle 3 = 70°
angle 4 = 110°

Intersecting lines #3
angle 2 = 40°
angle 3 = 140°
angle 4 = 40°

Working with Adjacent and Vertical Angles

1) <1 and <3
2) <2 and <4
3) 55°, 125°, 125°
4) 45°, 45°, 135°

Working with Adjacent and Vertical Angles   page 2

1) 58°
2) <MOK and <NOL
<KOL and <MON
3) <NOL = 58°, <NOM = 122°, <KOL = 122°

Use the drawings below to answer the questions:

1) RUQ or SUT
2) QUR and RUS, QUR is acute, RUS is obtuse
3) TUS = 70°

Working with Adjacent and Vertical Angles   page 2 (con't

Use the drawings below to answer the questions (last three questions on page 11)

1) <DPE and <FPA
2) <DPE and <CPB
3) 180°

All About Angles- Review

1) angle measures 35°   complement = 45°
2) angle measures 125°   supplement = 55°
3) 58°
4) 6°
5) 62°
6) 165°
7) 70°
8) 27°
9) 147°
10) 33°
11) 147°
12) answers will vary

page 2.

1) PON and NOM
2) PON and NOM
3) POK and LOM
4) KOL and LOM

Use the figure and word bank to answer the questions.

1) acute
2) QOV or VOS
3) Adjacent or supplementary
4) 115°
5) QOR , TOS
6) VOT, TOS
7) adjacent or supplementary

Vocabulary Challenge - Angle Analogies

1) more than 90°
2) supplementary
3) acute
4) vertical
5) less than 90°

Objective 48: Construct the perpendicular bisector of a line segment and the bisector of an angle using a straight edge.

Vocabulary

bisector
compass
arc
perpendicular
semicircle

Materials

Triman safety compasses
protractors
paper

Transparencies:

- Constructing a Perpendicular Bisector
- Bisecting an Angle

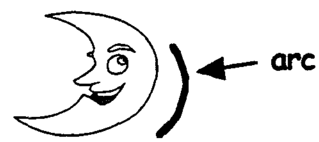
Student Copies:

- Drawing Perpendicular Bisectors
- Constructing Angle Bisectors
- Geometric Constructions
- Vocabulary Practice
- Word Search

Language Foundation

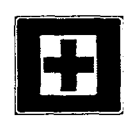
1. Some students may be familiar with the word bisect from science class. Divide the word into two parts: bi = two, sect = cut. Explain that **bisect** *means to cut or divide into two parts.* Further explain that the suffix -or refers to someone or something that performs the action. The **bisector** is the line used to divide something into parts.

2. Draw or show a quarter moon to represent an **arc**. Explain that this is only part of the full moon or full circle.



3. Review the word intersect from the previous lesson. Tell students that **perpendicular** is similar in meaning. Perpendicular lines meet at a certain point or intersect to form right angles. Ask students which capital letters form perpendicular lines: F, H, T, and L. Let students come up with other examples, such as road signs, which show perpendicular lines.

hospital

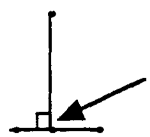


first aid

Mathematics Component

1. Review how to use a safety compass.
   - Remind students that we usually use a **compass** to create circles.
   - Point to the round disk on a compass and show students that it spins.
   - Have students feel the point on the back of the disk. Explain that this point is placed at the center of the circle.
   - Loosen the knob and demonstrate how the ruler setting moves back and forth. Show students that there is a metric and a standard side to the ruler.
   - Remind the students that you use the ruler to mark the radius of the circle. The diameter of the circle will be double the size set on the compass. (Example: For a six inch circle, you would set a three inch radius on the compass.)
   - Demonstrate creating a circle on the overhead projector.

2. Construct a perpendicular bisector to a line
   - Review the meaning of perpendicular. **Perpendicular** lines are lines which form a 90° (or right) angle when they meet or intersect.



These two line segments are perpendicular because they form right angles when they meet.

   - Review the meaning of bisect in the Language Foundation. Explain that in math a **bisector** is a line that creates <u>two equal pieces</u>.
   - Tell students that you will use a compass and a straight edge to learn how to construct a **perpendicular bisector** to a line. Ask students what they think a perpendicular bisector would be. Encourage students to think of the meaning of the words separately and then put them together. (A perpendicular bisector would be a line that divides another into two equal pieces and is perpendicular to the original line.
   - Each student needs a compass, a piece of paper and a pencil.
   - Place the <u>Constructing a Perpendicular Bisector</u> transparency on the overhead projector. Give students one direction at a time, uncovering one step at a time on the transparency. As you uncover and model each step, read the following directions aloud.

     Step 1: Use the side of the compass to draw a horizontal line segment across your piece of paper at about the middle of the paper.

     Step 2: Mark a point on the line. Label the point A.

     Step 3: Set your compass at 3/4 of an inch. **(Note**: Be sure students use the standard side of the ruler and not the metric side.) Place the point of the compass on point A and draw a **semicircle** above the line. A **semicircle** is exactly half of a circle. Label the points on the line B and C as shown here.

Step 4: Make your compass setting 2 inches. Place the point of the compass on point B and draw an **arc** above and an arc below the line. Show students that an **arc** is part of a circle between any two points.

Step 5: Don't change the compass setting. Place the point of the compass on point C and draw intersecting arcs above and below the line. Label the points of intersection W, A, and X.

Step 6: Use the ruler part of the compass to draw a straight line through points W, X, and A.

Step 7: Use a protractor to measure each of the four angles. Each angle should be 90°.

- Additional modeling may be done as needed using a clean transparency and a transparent compass on the overhead.
- The activity page Drawing Perpendicular Bisectors is provided for additional practice.

3. Bisecting an Angle
   - Remind students that in math a bisector divides something into two equal parts.
   - Ask students what they think an **angle bisector** does. (It divides an angle into two equal or congruent angles.)
   - Each student needs a compass, protractor, a piece of paper and a pencil.
   - Place the Bisecting an Angle transparency on the overhead projector. Give students one direction at a time, uncovering one step at a time on the transparency. Read the following directions as each step is uncovered and modeled.

     Step 1: Use the side of the protractor to draw an angle B. Label as you see in the diagram.

     Step 2: Set your compass at 1 inch. Place your compass on Point B and draw an **arc** intersecting the sides of angle B. Label the points of intersection A and C.

     Step 3: Set your compass at 1/2 inch. Place your compass on Point A and draw an arc.

     Step 4: Using the same compass setting, place your compass on Point C and draw an arc that intersects, or crosses over, the arc you just drew. Label the point of intersection X.

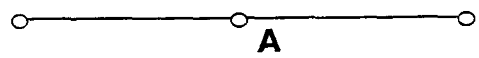
     Step 5: Draw ray BX. Use a protractor to prove that the measure of angle ABX equals the measure of angle XBC
   - Ask, " How would measures of angle ABX and angle XBC compare if the measure of angle ABC decreased?" (The two angles would be smaller but their measures would stay equal.)
   - Ask, "What if it increased?" (The two angles would be greater but their measures would stay equal.)
   - The activity sheet Constructing Angle Bisectors is provided for further practice with this concept.

- A Geometric Constructions activity sheet incorporating both perpendicular bisectors of lines and bisecting angles may be assigned as additional review. Circulate and help students work through the steps.
- The activity sheets Vocaulary Practice and Word Search are provided for reinforcement and review of language presented in this objective and previous objectives.

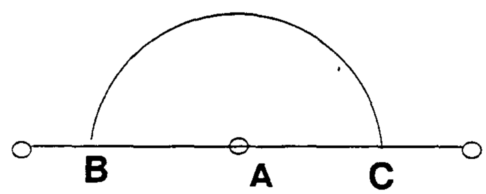
Transparency

Constructing A Perpendicular Bisector

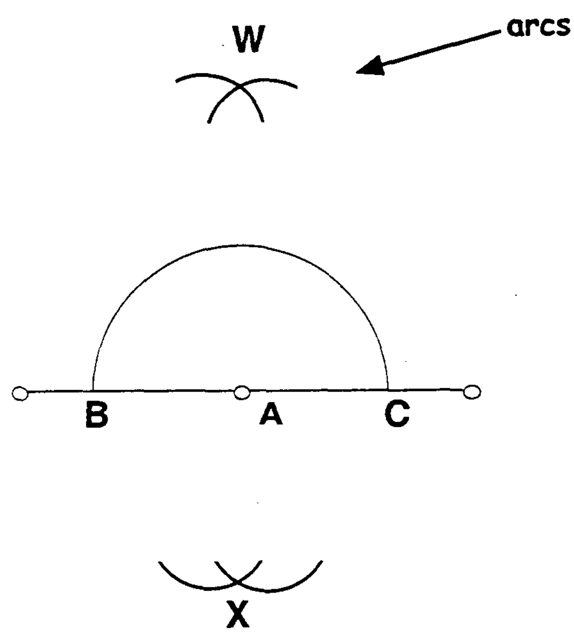
STEPS 1 & 2



STEP 3

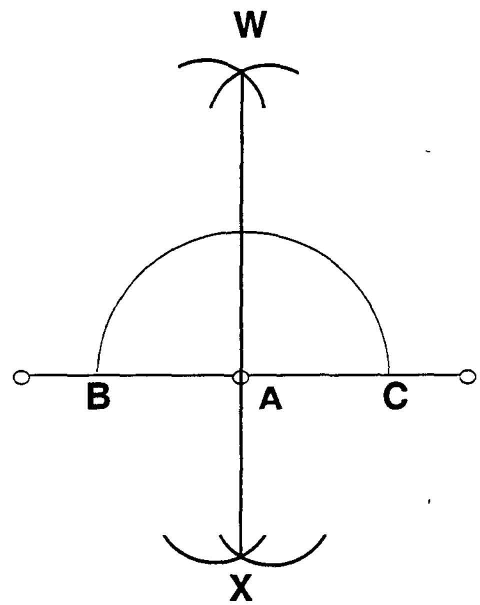


STEPS 4 & 5

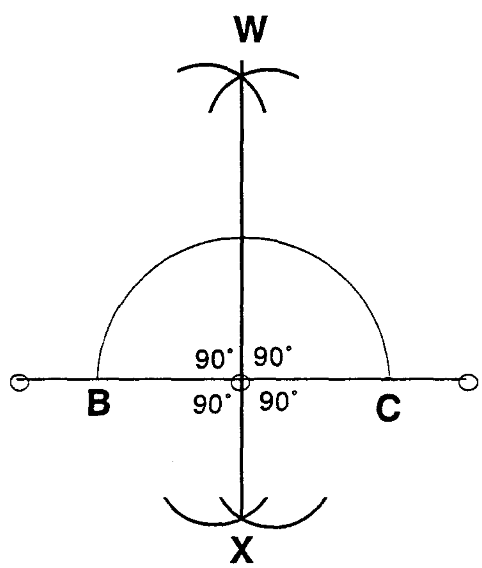


Constructing a Perpendicular Bisector (cont.)

STEP 6



STEP 7

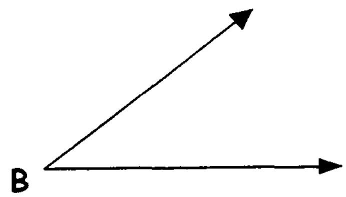


$\overline{WX} \perp \overline{BC}$

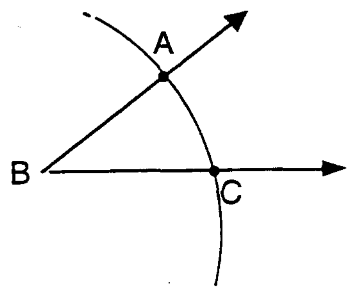
Bisecting an Angle

Transparency

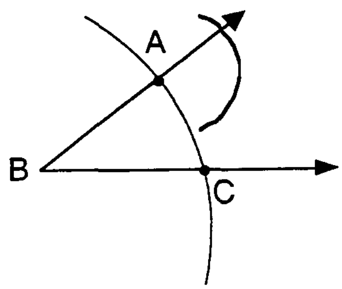
STEP 1



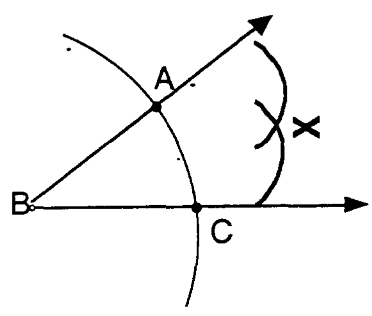
STEP 2



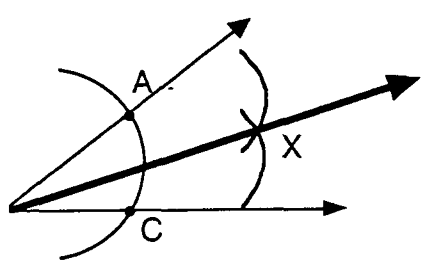
STEP 3



STEP 4



STEP 5

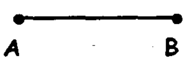


Name: ____________________

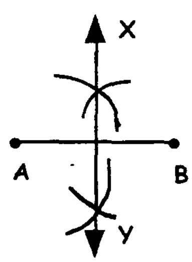
Drawing Perpendicular Bisectors

Perpendicular Bisector- Line Segment

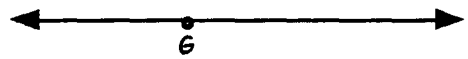
$\overline{AB}$



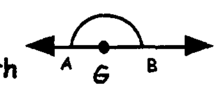
- Set your compas at a little more than 1/2 the length of $\overline{AB}$.
- Put the compas point on A and draw an arc above and below $\overline{AB}$.
- Put the compas point on B and draw an arc above and below $\overline{AB}$
- Draw line $\overline{XY}$.



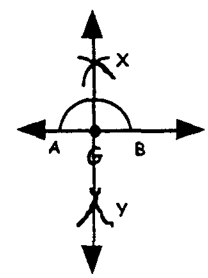
Perpendicular Bisector- Given a Point on a Line



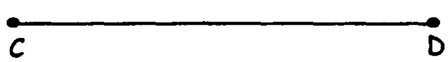
- Set your compas at about 3/4 in.
- Put the compas point on G and draw a semicircle above the line. Mark the points of intersection with the line. (Points A, B)

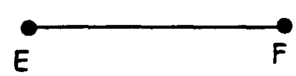


- Put the compas point on A and draw an arc above and below $\overline{AB}$. (Set your compas at a radius a little larger than $\overline{AG}$.)
- Repeat with point B.
- Draw line XY through point G..



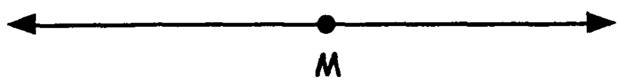
Construct the perpendicular bisector:

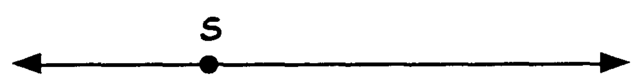


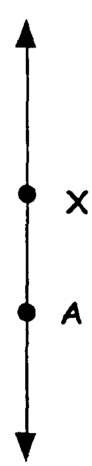


Drawing Perpendicular Bisectors   page 2

Construct the perpendicular bisector to a given point:



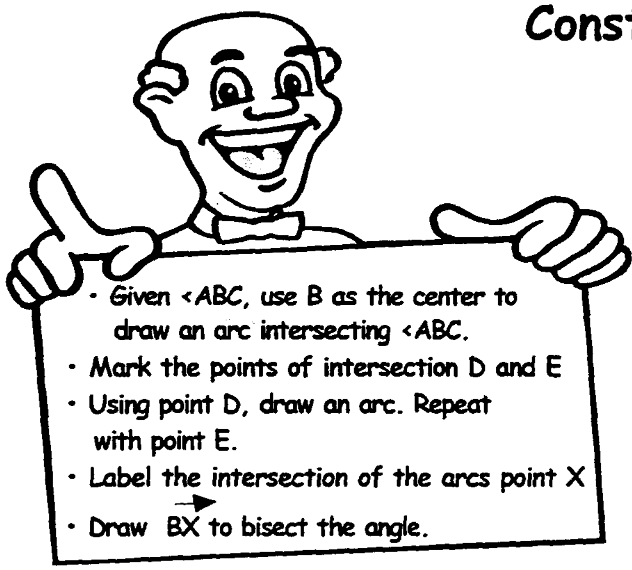


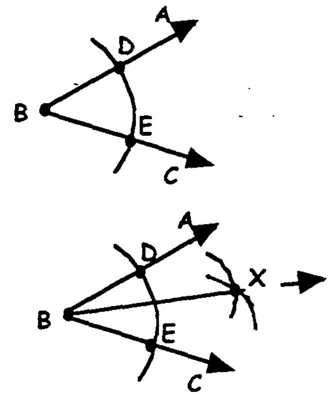


Draw : AX ⊥ to ST at Point X

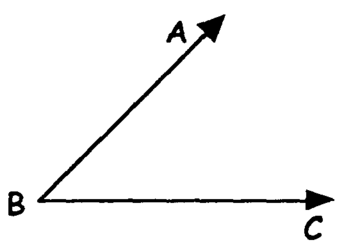
Name:________________

Constructing Angle Bisectors

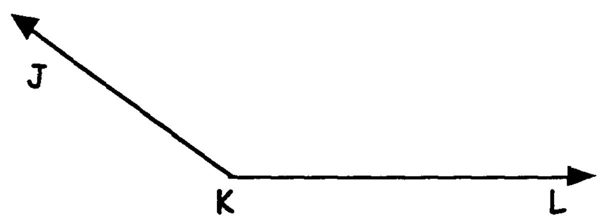




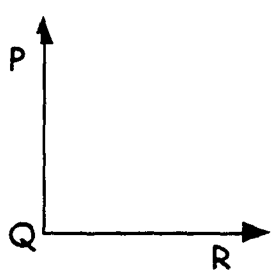
1) Bisect $\angle ABC$.



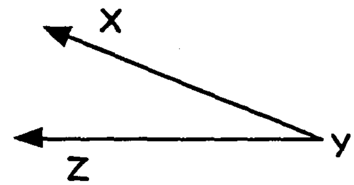
2) Bisect $\angle JKL$.



3) Bisect $\angle PQR$.



4) Bisect $\angle XYZ$.



Constructing Angle Bisectors

5) Use your protractor to draw a 100° angle, then bisect the angle.

6) Use your protractor to draw an 80° angle. Use angle bisection to form a 60° angle.

7) Use your protractor to measure each of the bisected angles on page 1. Are they both congruent?

Problem 1 - Measure of each bisected angle ________ ________

Problem 2 - Measure of each bisected angle ________ ________

Problem 3 - Measure of each bisected angle ________ ________

Problem 4 - Measure of each bisected angle ________ ________

Name ________________

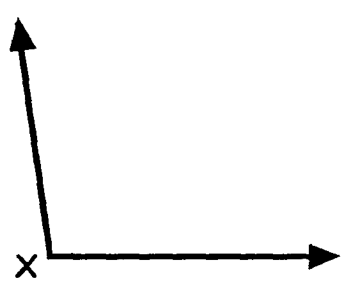
Geometric Constructions

Construct a perpendicular bisector CD to line AB. Use a protractor to prove that line AB $\perp$ line CD.

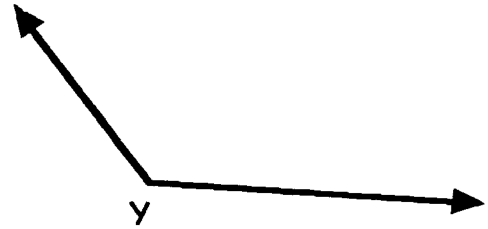
1.

Construct angle bisectors to angle x and angle y. Use a protractor to prove that you have bisected each of the angles.

2.

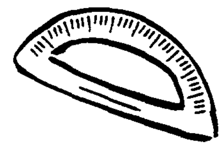


3.



Name ______________________

Vocabulary Practice



1. What is an arc? ______________________________________

   Draw one below.

2. What does the prefix "bi" mean? What does it mean when you bisect something?

   "bi" = ________________

   ____

   ____

3. Can you name 2 types of constructions that use bisectors? Draw an example of 1 type.

   ____________________ ____________________

4. What is the difference between a ray and a line?

   ____

   ____

5. Draw a right angle.

6. What do we use a compass for in math?

   ____

   ____

Vocabulary Practice

7. Explain in words how you bisect an angle. List the steps.

____

____

____

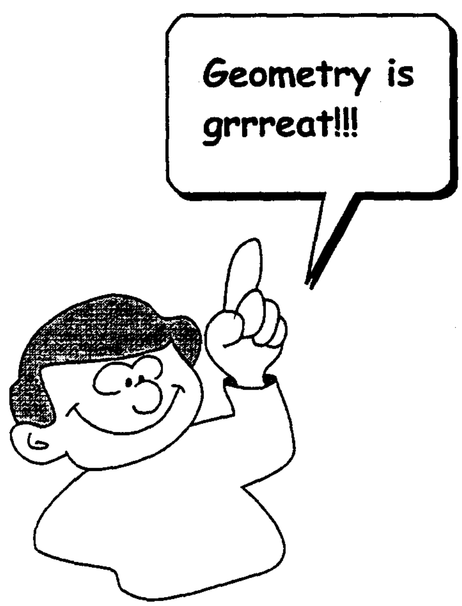
8. What is a semicircle? Give an example of where you might see a semicircle in everyday life.

____

____

9. Try this analogy:

   line segment : line as ____________ : circle



Name ________________ Vocabulary Word Search

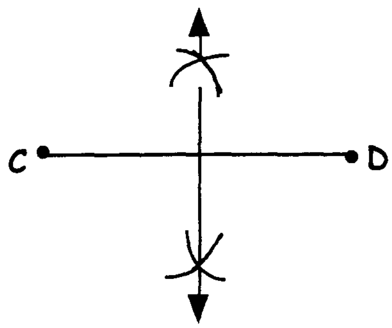
Find the vocabulary words among the letters in the boxes below. They will be spelled horizontally, vertically, or diagonally.

1. angles
2. arc
3. bisector
4. compass
5. construction
6. geometry
7. lines
8. perpendicular
9. ray
10. semicircle

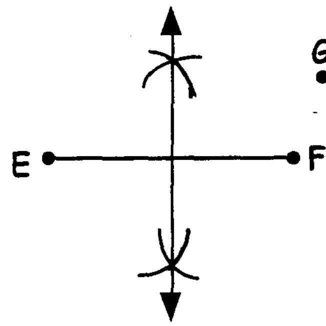
B	M	S	E	M	I	C	I	R	C	L	E	X
A	S	D	F	G	H	C	B	L	O	Q	W	R
Q	T	Y	I	O	P	O	I	Z	X	C	V	S
L	K	J	H	G	H	N	S	Q	W	E	S	S
N	M	L	K	I	U	S	E	H	G	A	D	Z
F	G	K	M	N	B	T	C	A	P	A	W	T
B	V	C	X	Z	A	R	T	M	P	Y	U	O
P	I	U	Y	T	R	U	O	M	C	G	J	F
A	N	G	L	E	S	C	R	F	S	E	R	B
R	S	D	F	G	H	T	I	O	N	O	V	Z
C	C	X	Z	B	R	I	M	T	Q	M	D	F
T	R	Y	R	A	Y	O	P	G	W	E	U	V
H	R	E	U	O	C	N	D	S	P	T	S	L
J	H	D	F	S	R	W	Z	S	R	R	W	P
S	D	Y	U	I	W	B	L	A	S	Y	M	N
P	E	R	P	E	N	D	I	C	U	L	A	R
K	N	S	D	E	R	G	N	A	R	T	E	N
Z	X	C	V	B	B	N	E	M	U	D	S	F
T	R	W	X	Y	Z	W	S	Q	E	L	E	M
J	K	L	R	W	A	E	P	I	O	U	W	Q

Answer Key
Obj. 46

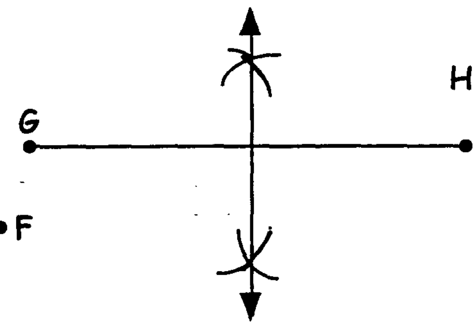
Drawing perpendicular Bisectors



Set compass at $1\frac{1}{2}$ "

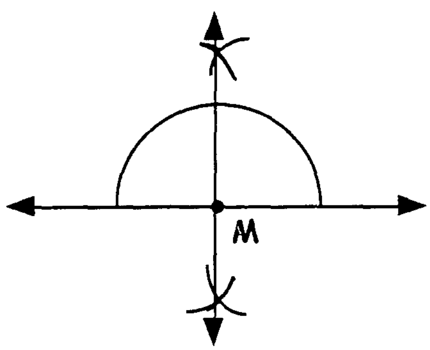


Set compass at 1 "



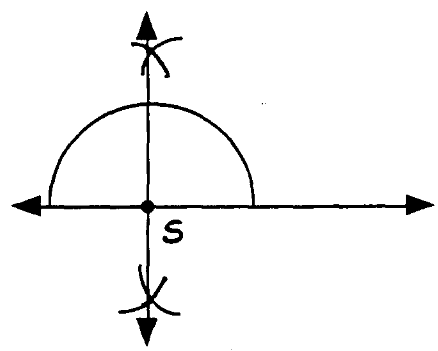
Set compass at $1\frac{3}{4}$ "

Drawing perpendicular Bisectors p.2



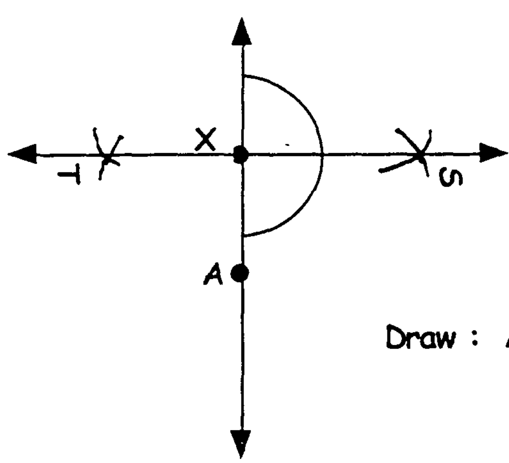
Set compass at 1 " - draw the semicircle

Set compass at $1\frac{1}{8}$ " - draw the arcs



Set compass at $\frac{3}{4}$ " - draw the semicircle

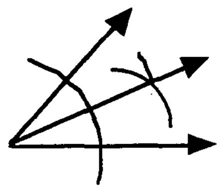
Set compass at 1 " - draw the arcs



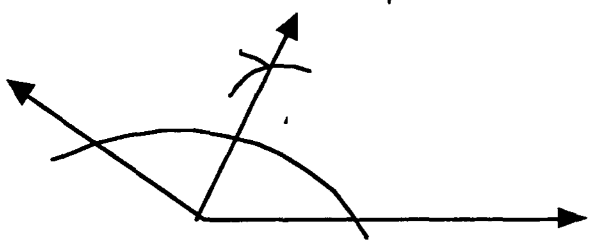
Draw : AX $\perp$ to ST at Point X

Constructing Angle Bisectors

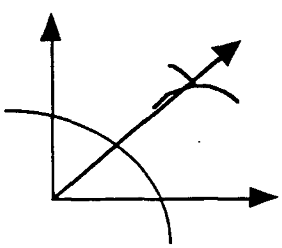
1) <ABC Set compass to 1" to draw big arc
Set compass to $\frac{1}{2}$ " to draw 2 smaller arcs



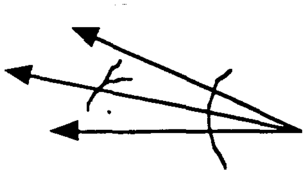
2) <JKL Set compass to 1" to draw big arc
Set compass to $1\frac{1}{4}$ " to draw 2 smaller arcs



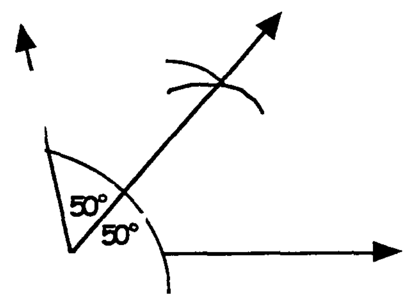
3) <PQR
Set compass to $\frac{3}{4}$ " to draw big arc
Set compass to 1" to draw 2 smaller arcs



4) <XYZ
Set compass to 1" to draw big arc
Set compass to $\frac{1}{2}$ " to draw 2 smaller arcs

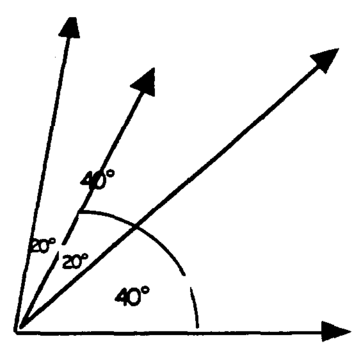


5) 100° angle



6) from an 80° angle.form a 60° angle

Bisect 80° into 40° and 40°.
Bisect 40° into 20° and 20°.



7) Measure each of the bisected angles. *Answer Key*

Problem 1 - each angle = 23°
Problem 2 - each angle = 71°
Problem 3 - each angle = 45°
Problem 4 - each angle = 11°

Geometric Constructions

1. Perpendicular lines should create four 90° angles.
2. The angle bisector should create two approx. 48° angles.
3. The angle bisector should create two approx. 66° angles.

Vocabulary Practice

1. Part of a curve between any two points
2. Two - to cut something into 2 parts
3. Perpendicular bisectors, angle bisectors
4. A line goes on to infinity in 2 directions. It has an infinite set of points in a straight path. A ray has an end point. It goes on to infinity in one direction.
5. ∟
6. To make circles, arcs.
7. Draw an angle. Draw an arc intersecting both rays of the angle. Use the points of intersection on both rays to draw arcs inside the angle.
   Draw a ray through the intersection of the two arcs.
8. Half a circle. Half moon, orange slice, protractor, half a pie, open Chinese fan.
9. Arc

Vocabulary Word Search

Find the vocabulary words among the letters in the boxes below. They will be spelled horizontally, vertically, or diagonally.

1. angles
2. arc
3. bisector
4. compass
5. construction
6. geometry
7. lines
8. perpendicular
9. ray
10. semicircle

B	M	S	E	M	I	C	I	R	C	L	E	X
A	S	D	F	G	H	C	B	L	O	Q	W	R
Q	T	Y	I	O	P	O	I	Z	X	C	V	S
L	K	J	H	G	H	N	S	Q	W	E	S	
N	M	L	K	I	U	S	E	H	G	A	D	-
F	G	K	M	N	B	T	C	A	P	A	W	T
B	V	C	X	Z	A	R	T	M	P	Y	U	O
P	I	U	Y	T	R	U	O	M	C	G	J	F
A	N	G	L	E	S	C	R	F	S	E	R	B
R	S	D	F	G	H	T	I	O	N	O	V	Z
C	C	X	Z	B	R	I	M	T	O	M	D	F
T	R	Y	R	A	Y	O	P	G	W	E	U	V
H	R	E	U	O	C	N	D	S	P	T	S	L
J	H	D	F	S	R	W	Z	S	R	R	W	P
S	D	Y	U	I	W	B	L	A	S	Y	M	N
P	E	R	P	E	N	D	I	C	U	L	A	R
K	N	S	D	E	R	G	N	A	R	T	E	N
Z	X	C	V	B	B	N	E	M	U	D	S	F
T	R	W	X	Y	Z	W	S	Q	E	L	E	M
J	K	L	R	W	A	E	P	I	O	U	W	O

Objective 49: Identify the parts of a circle, including diameter, radius, circumference, arc, chord, and center.

Vocabulary

circle
diameter
radius /radii
circumference
arcs
chords
center

Materials

Transparencies:

Parts of a Circle

Student Copies:

Parts of a Circle
Parts of a Circle Activity Sheet
Circular Activity Sheet
All About Circles

Language Foundation

1. The vocabulary relating to a **circle** will be taught in the lesson. Allow students ample opportunities to practice saying words by modeling aloud.

2. Many words that begin with **circ** have a meaning related to circles. Have students look at the following words and discuss their meaning :

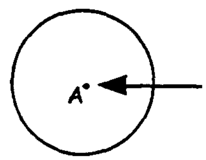
   circulate / circulation
   circular
   circus

3. For Spanish speakers, point out that circumference has a cognate in the translation: "circunferencia."

4. Point out that the plural of the word **radius** is radii.

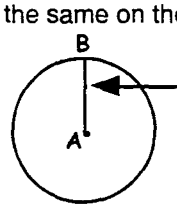
Mathematics Component

1. Introduce the parts of a circle.
   - Place the <u>Parts of a Circle</u> transparency on the overhead projector.
   - Distribute copies of <u>Parts of a Circle</u> to students.
   - As the class works through the lesson, use an overhead pen to mark the parts of a circle on the transparency and instruct the students to record information on their papers.
   - Label the center of the circle A . Ask students what they know about the center of a circle. (The center is the same distance from any point on the circle.) Tell students that circles are named by their center. Fill in the blank for number 1 on the transparency and have students do the same on their papers. (circle A)



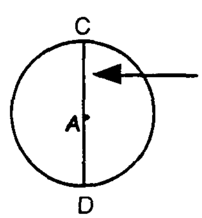
This is the center of the circle . Say *"Circle A."*
Write <u>circle A</u>.

   - Draw a radius, remind students that a radius goes from the center to any point on the circle. Say that it is a line segment and should be named with the appropriate marking. Fill in #2 on the transparency and have students do the same on their papers. ($\overline{AB}$)



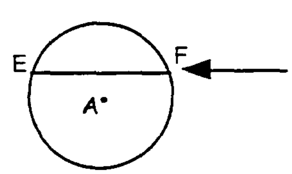
This a radius. Say *"Segment AB."*
Write $\overline{AB}$.

   - Draw a diameter, remind students that a diameter goes from a point on the circle through the center to another point on the circle. Say that it is a line segment and should be named with the appropriate marking. Fill in #3 on the transparency and have students do the same on their papers. ($\overline{CD}$)



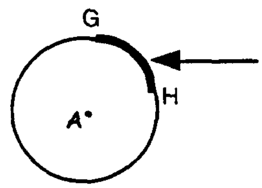
This a diameter. Say *"Segment CD."*
Write $\overline{CD}$.

   - Ask, "What is the relationship between diameter and radius?" (The radius is half the diameter or the diameter is twice the radius.)
   - Draw a chord. Remind students that a chord goes from any point on a circle to any other point on the circle. It may or may not go through the center point. (A diameter is a type of chord.) It is a line segment and should be named with the appropriate marking. Fill in #4 on the transparency and have students do the same. ($\overline{EF}$)



This a chord. Say *"Segment EF."*
Write $\overline{EF}$.

- Ask, "What is the relationship between chords and diameters?" (A diameter is the longest chord in the circle.)
- Darken any arc on the circle. An arc is any part of the outside edge of the circle named by two endpoints. Ask students to name any other arcs they can find on the circle. (Answers will vary. Arcs of different sizes may be found as long as they have two endpoints named.) Fill in #5 on the transparency and have students do the same on their papers. ($\overset{\frown}{GH}$)

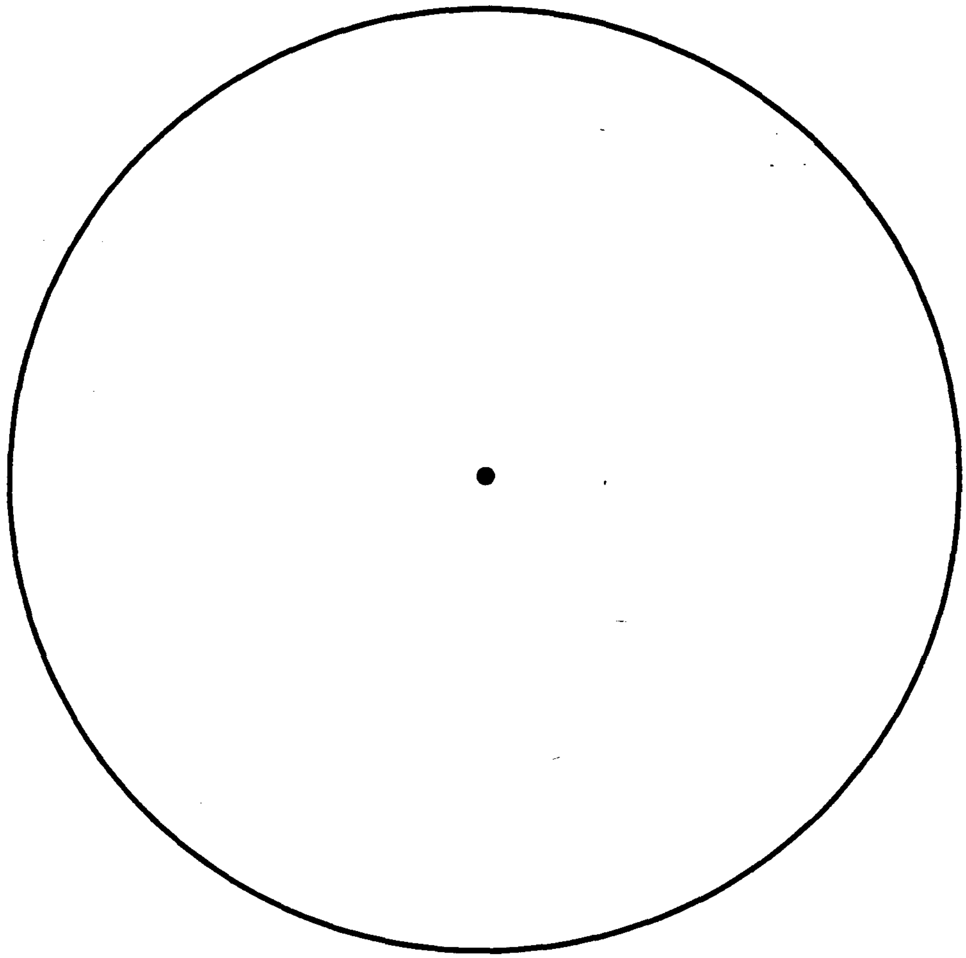


This an arc. Say *"Arc GH."* Write $\overset{\frown}{GH}$.

- Write the word circumference around the circle. Ask students to describe the circumference of a circle. The circumference is the perimeter or the distance around the outside of the circle. Fill in #6 on the transparency and have students do the same on their papers. (Perimeter or distance around the outside of the circle.)

- The activity sheets <u>Circular Activity Sheet</u> and <u>All About Circles</u> are provided for additional reinforcement of the math and language introduced in this lesson.

Parts of a Circle



1. Name the circle: ______________
2. Name a radius: ______________
3. Name a diameter: ______________
4. Name a chord: ______________
5. Name an arc: ______________
6. Describe the circumference: ________________________________

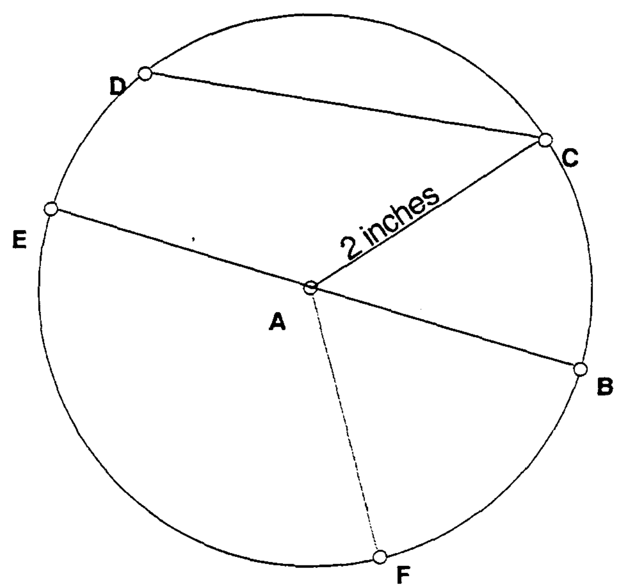
____

Name ______________________

Circular Activity Sheet

Use the figure at the right to answer questions 1-6.

1. Name the circle.



2. Name 4 radii .

3. Name the diameter.

4. Name 2 chords.

5. Find the length of the radius.

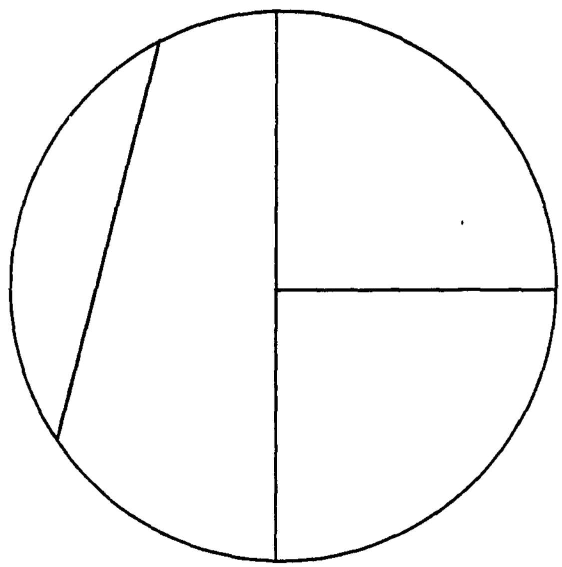
6. Find the length of the diameter.

Name ____________________

All About Circles

Word Bank:	chord	circumference	diameter	radius	arc

I. LABEL one of each of the above terms on the circle.



II. Fill in the blanks with the appropriate words from the word bank.

1. The ____________________ is the distance across the circle through its center.

2. The distance around the outside of the circle is its ____________________.

3. A part of the circumference named by two endpoints is an ________________ .

4. A line that goes from any one point on the circle to any other point on the circle is a ____________________.

5. The distance from any point on the circle to the center of the circle is called the ________________ .

Answer Key
Obj. 49

Part of a Circle
(See illustrations in mathematics component.)

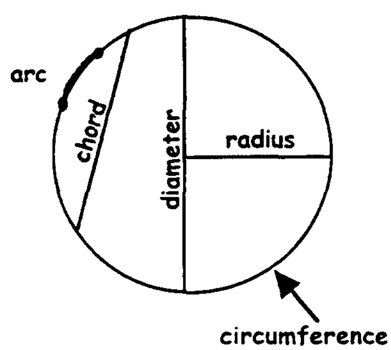
1. Name the circle: circle A
2. Name a radius: $\overline{AB}$
3. Name a diameter: $\overline{CD}$
4. Name a chord: $\overline{EF}$
5. Name an arc: $\overset{\frown}{GH}$
6. Describe the circumference: the distance around the circle

Parts of a Circle Activity Sheet

1. circle A
2. $\overline{AC}$, $\overline{AB}$, $\overline{AF}$, $\overline{AE}$
3. $\overline{BE}$
4. $\overline{CD}$, $\overline{BE}$
5. 2 inches
6. 4 inches

All About Circles

1. diameter
2. circumference
3. arc
4. chord
5. radius



Objective 50: Develop and apply formulas to find perimeter and area of rectangles, triangles, and parallelograms.

Vocabulary

perimeter
area
perpendicular
length
width
height
formula
base

Materials

centimeter cubes
transparent centimeter cubes
transparent inch tiles

Transparencies:
- Centimeter Grid Paper
- Rectangle Challenge

Student Copies:
- Centimeter Grid Paper
- Perimeter of a Rectangle
- Perimeter and Area of Rectangles
- Perimeter and Area of Parallelograms
- Perimeter and Area of Triangles
- Perimeter of Polygons
- Area of Polygons
- Vocabulary Practice
- Area and Perimeter Performance Task

Language Foundation

1. **Perimeter** and circumference are similar in meaning. Explain that perimeter is the distance around a 2 dimensional figure. Students have learned that circumference is the distance around the outside of a circle. Thinking about the perimeter of a circle (circumference) might help students understand the perimeter of other figures.

   Point out that the word perimeter has the word rim in it. Draw a picture of a basketball goal on the board or on a transparency; show students the rim. Relating the word rim in perimeter to the rim around a basketball goal might help students visualize the meaning of the word - the distance around a figure.

   Ask students to point out objects in the room such as the desks, a book, or the blackboard that they could measure the distance around. Have them consider the walls also. Brainstorm with students how they might determine the perimeter of rectangles, parallelograms, and triangles in this lesson.

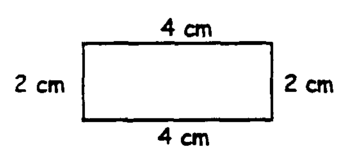
2. Tell students they will also learn how to determine the **area** of a figure. Compare perimeter - the measure of the outside of a figure - with area - the measurement of the inside of a figure.

3. For Spanish Speakers, point out that the words perimeter and area have the following cognates in Spanish: "perímetro" and "área".

Mathematics Component

Perimeter of a Rectangle

1. Use centimeter grid paper to investigate the perimeter of a rectangle.
   - Distribute centimeter grid paper to each student.
   - Ask students to draw a rectangle with a width of 3 centimeters and a length of 4 centimeters. Model by using the transparency provided. Explain that this is called a 3 by 4 rectangle (3 x 4).
   - Ask, " If you were going to make the same size rectangle with string, how long should the string be? How do you get the answer?" (The answer is 14 centimeters because the sides are 3+ 3 + 4 + 4.)
   - Tell students that this distance around the outside of the rectangle is called the **perimeter**. Then explain that **perimeter** is the total distance around the outside of any polygon.
   - Have students draw a 2 x 5 rectangle.
   - Ask, " What is the perimeter of this figure?" (2 + 2 + 5 + 5 =14 centimeters) Have a student explain how he or she got the answer. (Add the length of each of the four sides.)
   - Ask students if they can draw a rectangle with a perimeter of 6. Have a student demonstrate the solution on the overhead by showing and counting the centimeters along the outside edge. (The dimensions of the rectangle would be 1 x 2.)
   - Challenge students to find and draw a rectangle with a perimeter of 16 centimeters. Have one student come up and demonstrate a solution. Ask if other students found a different rectangle with a perimeter of 16 centimeters. (There are four possible rectangles which can be drawn with a perimeter of 16: 3 x5 or 4 x 4 or 2 x 6 or 1x7.) Have students share different solutions on the overhead using transparency grid paper. Then explain that the shape of the rectangle can vary, even though the perimeter stays the same.
   - Draw the following rectangle on a clean transparency and ask students to find the perimeter.



   Have a student explain their answer. (The perimeter is 4 + 4 + 2 + 2 which is 12 centimeters.)
   - Ask students if they see a faster way to find the sum of the four sides. Allow students to offer suggestions for finding the sum of the sides in a faster way. Lead them to understand that one fast way would be: adding the length (L) and width (W) and then doubling that sum: 2(l + w)
   - Write P = 2(l + w) on the board. Explain that this is called a **formula**. Tell students that a formula in math is like a recipe when we are cooking - it tells us <u>how</u> to do something. Point to the formula for the perimeter of a rectangle on the board. Say, "What does this formula tell us <u>how</u> to do?" (It tells us how to find the perimeter of a rectangle - by adding a length and width <u>first</u> and then doubling the sum.) A variation of the formula for perimeter that can also be used is: P = 2l + 2w (Double the length, double the width, and add.)

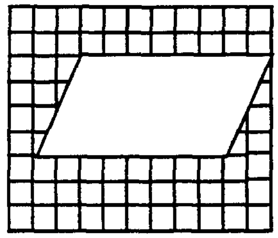
- The activity sheet Perimeter of a Rectangle is provided for additional reinforcement.

Perimeter and Area of a Rectangle

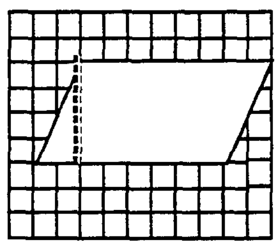
1. Use centimeter grid paper to investigate the area of a rectangle.
   - Ask the students to draw a rectangle with dimensions of 3 x 6.
   - Ask, "If you were to fill the inside of this rectangle with centimeter tiles, how many would it take? Try it." Model the solution using transparent tiles on the overhead. (18 square centimeter tiles)
   - Tell students that this is called the **area** of the rectangle. Say, "**Area** is the number of square units of surface which a figure covers."
   - Have students draw a rectangle with dimensions of 4 x 5 on the grid paper. Ask, "What do you think the area of this rectangle will be? How many square centimeter units will fill the inside of the figure?" Have students make a guess and then try it. Model the solution using transparent tiles. (20 square centimeters)
   - Look back with students at the two rectangles just completed. Ask students if there is a way to find the area without placing tiles inside the figures. Lead them to understand that the area of rectangles can be determined by multiplying length times width.
   - Introduce the **formula**: Area of a Rectangle = length x width or **A = lw**. Say, "What does this formula tell us how to do?" (It tells us how to find the **area** of a rectangle - by multiplying the length times the width.)
   - Tell students that you want to create a rectangle with an area of 24 square centimeters. Ask students what the length and width of the rectangle might be. Have them model solutions on the overhead. (2 x 12 or 3 x 8 or 6 x 4 or 1 x 24)
   - Review the meaning of **perimeter**. (Perimeter is the distance around the outside of a figure.)
   - Ask students to talk about the difference between **perimeter** and **area**. Perimeter is the distance around the outside of a figure and area is the number of square units inside the figure.
   - Have students use geoboards and work with a partner to complete the activity Rectangle Challenge.
   - The activity sheet Perimeter and Area of Rectangles will provide additional practice with perimeter and area of rectangles.

Perimeter and Area of a Parallelogram

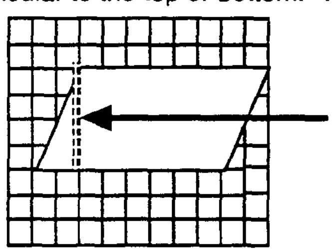
1. Use centimeter grid paper to investigate perimeter and area of a parallelogram.
   - Distribute centimeter grid paper to each student.
   - Draw the following parallelogram near the top of the transparency grid paper. (8 x 4)
     Have students draw the same figure. Review that a parallelogram has two sets of parallel lines.



- Have one student come up and trace over the perimeter of the parallelogram. Discuss the fact that it would be hard to find the **perimeter** of this figure by counting square units. Ask for suggestions on how we might find the perimeter. (The perimeter could be found by measuring the length of each side with a ruler and then adding the four numbers.)
- Ask students to give the **area** of the parallelogram. (They will probably struggle with this and tell you that it is difficult to count the exact number of square units because some are only partial units.)
- Have several students **estimate** what the area would be. Accept answers close to 32 sq. units.
- Draw a dotted line segment as shown below and have students do the same. Show students that the line segment is **perpendicular** to the top and bottom of the parallelogram. (Remind students that perpendicular lines form a 90° angle where they intersect.)

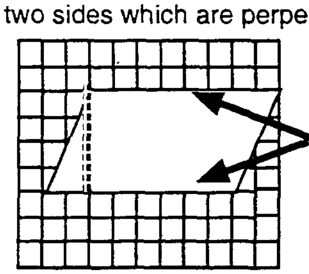


- Explain that this is the **height** of the parallelogram. The **height** of a figure must form a right angle with the top or bottom. (The sides of the parallelogram can not be the height because they are not perpendicular to the top or bottom. The height must be drawn in.)



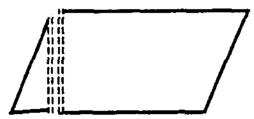
This is the **height**. The height is perpendicular to the top and the bottom of a parallelogram.

- Explain that the two sides which are perpendicular to the height are called the **bases** of the parallelogram.

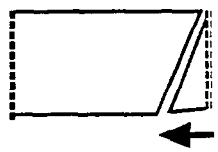


These are called the **bases**. The bases are perpendicular to the height.

- Have students cut out their parallelogram. Say, "This is the total **area** of the parallelogram." (Cut one extra paper parallelogram to use for demonstration.)
- Ask them to cut the parallelogram into two pieces along the dotted line as shown below.



- Ask students if they can move the two pieces around to form a **rectangle**. (Pick the triangular piece up and move it across to the other side.) Model the solution.

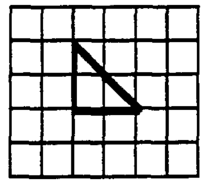


- Ask students if the area of the figure has changed. (No, because you have not added or taken away any square units. You have only moved them around.)
- Have students use the grid paper to determine the length and width of the rectangle. (The length is 8 centimeters and the width is 4 centimeters.)
- Ask, " What is the **area** of the rectangle?" (Area = l x w or 32 square centimeters.)
- Point to the parallelogram on the transparency and ask, "What is the area of the parallelogram? Why?" (The area is 32 square centimeters because it is the <u>same</u> as the area of the rectangle. We did not add or remove any square units when we cut the parallelogram out. We just moved the pieces around to form a rectangle.)
- Have students suggest a way to prove that the two areas are the same. (Place the paper pieces of the rectangle over the parallelogram on the transparency.)
- Ask students, "How does the <u>length</u> of your rectangle compare with the <u>base</u> of the parallelogram." (They are the same - 8 centimeters.)
- Ask, "How does the width of the rectangle compare to the height of the parallelogram?" (They are the same - 4 centimeters.)
- Introduce the **formula**: Area of a parallelogram = length of the base x height of the figure or **A = bh**.
- Ask students, "What does this formula tell us how to do?" (It tells us how to find the area of a parallelogram - multiply the base times the height.)
- The activity sheet <u>Perimeter and Area of a Parallelograms</u> is provided for further reinforcement.

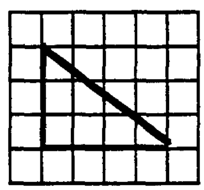
<u>Perimeter and Area of a Triangle</u>

1. Investigate the perimeter and area of triangles.
    - Instruct students to draw a right triangle of any size on their cm grid paper. Remind the class that a right triangle has one right angle.

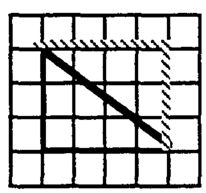
- Draw the following size right triangle on a transparency grid paper.



* Have a student come up and trace over the **perimeter** of the triangle. Ask students why they would need a ruler to measure the perimeter of this triangle. (One side does not cover an even amount of units.)
- Ask students to estimate the **area** of the transparency triangle using the grid. (1 whole square unit and 2 half square units = 2 square units)
- Remind students that area is the total amount of square units inside a polygon.
- Ask students to estimate the area of their own right triangles. Point out that some students can accurately count the number of square units, but others can not.)
- Explain that the "counting squares" strategy works well on some triangles, but not on others. Show an example of one that can not be easily counted.

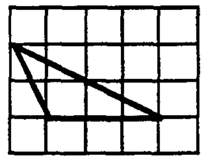


- Ask, "Since we can not accurately count the square units inside this triangle, how do you think we might find the **area** ?" (Students may suggest using a formula, making a rectangle, etc.)
- Demonstrate that they can make the triangle into a rectangle by drawing a matching piece as shown below. Say, "Making the triangle into a rectangle will help us find the area of the triangle."

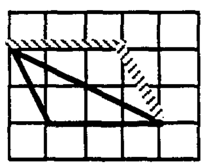


- Ask, "What is the area of this **rectangle**?" (A = length times width or 12 square units)
- Say, "Therefore, what is the area of the **triangle**?" (The triangle is <u>half</u> the rectangle so the area is 6 square units.)
- Ask, "Do you think we could make <u>all</u> types of triangles into rectangles to help us find the area ?" (Some students may say yes, and some may say no.)
- Tell students that to prove whether or not this works they can try this method on another triangle.
- First, instruct students to draw an acute triangle. (You may need to remind students that in an acute triangle all three angles measure less than 90°.)

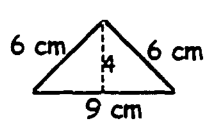
- Allow some students who were able to make their triangle into a rectangle demonstrate on the overhead.
- Then say, "Let's look at another example." Draw the following obtuse triangle on the grid paper. Remind students that an obtuse triangle has one angle which measures greater than 90°.



- Ask students if they can make this triangle into a rectangle. (No)
- Explain that counting squares or turning the triangle into a rectangle doesn't work well in this situation.
- Ask, "What shape will you get if you double the triangle?" Demonstrate that it is a **parallelogram**.



- Remind students that they have learned a **formula** for finding the area of a parallelogram. Write the formula **A = bh**.
- Have one student point to the base of the parallelogram. (It could be the top or the bottom of the parallelogram.) Say, "How many centimeters is the base?" (3 centimeters)
- Remind students that the base and height must be <u>perpendicular</u>. Have a student draw a dotted line to show the height of the parallelogram. Ask, "How many centimeters is the height?" (The height is two centimeters.)
- Help students apply the formula to determine the area of the parallelogram. (A = bh; so A = 3 x 2 or 6 <u>square</u> centimeters)
- Ask, "What is the relationship between the triangle and the parallelogram?" (The triangle is half of the parallelogram.)
- Tell students that since the triangle is half of the **parallelogram**, the formula for area of a triangle is A= 1/2 bh <u>or</u> $A = \frac{bh}{2}$.
- Draw the following triangle and model how to substitute numbers into the formula to find the area of other triangles whose measurements are given.



A = 1/2 bh
A = 1/2 (9 • 4)
A = 1/2 (36)
A = 18 sq. cm

- Have students complete the activity sheet <u>Area and Perimeter of Triangles</u>.

Centimeter Grid Paper

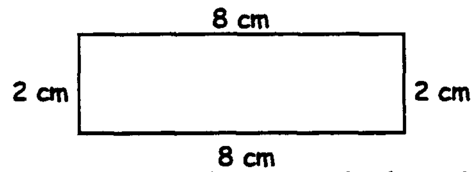
Name ____________________

Perimeter of a Rectangle

The distance around any object is called the **perimeter**. The perimeter of a rectangle is easy to find. You can find the sum of all sides or use a special formula.

Example:

Find the perimeter of this rectangle.



Find the sum of all sides

$P = s + s + s + s$
$P = 8 + 8 + 2 + 2$
$P = 20$ cm

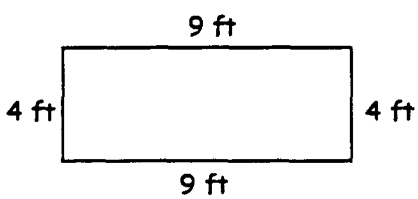
or

Use a special formula

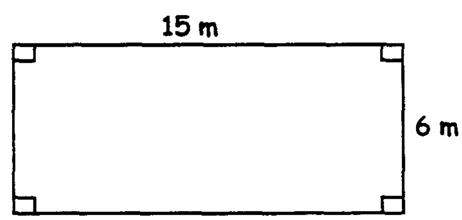
$P = 2\,(l + w)$
$P = 2\,(8 + 2)$
$P = 2\,(10)$
$P = 20$ cm

Find the perimeter of these rectangles. Show your work.

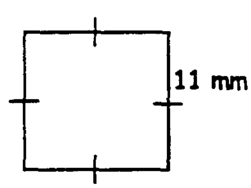
1)



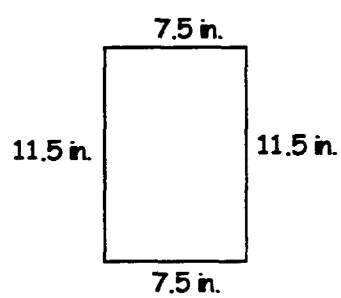
2)

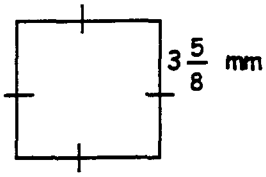


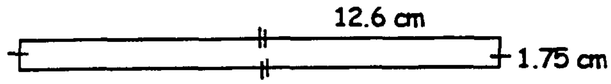
3)

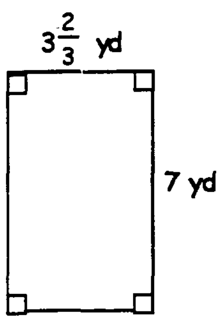


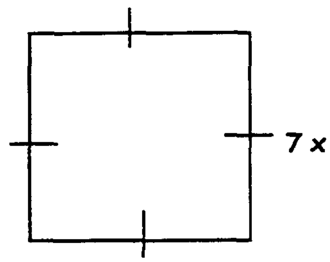
4)

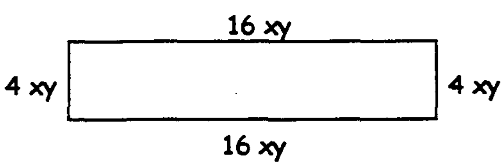


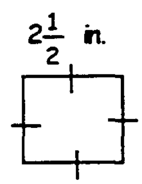
5) 

6) 

7) 

8) 

9) 

10) 

<u>Solve these problems. Draw a picture and show your work.</u>

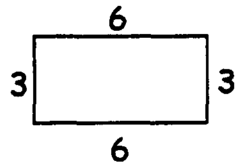
1) Hector built a rectangular fence around his backyard. He used a total of 48 feet of fencing, including the gate. If two sides of the fence are 10 feet each, how long are the other two sides?____________

2) Maya has 14.2 inches of gold string that she wants to glue around a square picture frame. Does she have enough string if one side of the frame measures 3.6 inches? __________ How do you know?

Rectangle Challenge!

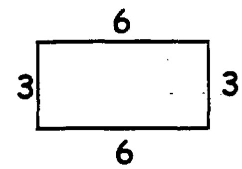
Transparency

perimeter = sum of all sides (s)



P = s + s + s + s
P = 3 + 6 + 3 + 6
P = 18 units

area = l x w



A = l x w
A = 6 x 3
A = 18 square units

Use a geoboard and work with a partner.

1) One person in each pair will make a rectangle on the geoboard.

2) The second person in each pair will find the perimeter and the area of the rectangle and explain how they got their answer.

3) Then the second person will make a rectangle on the geoboard.

4) The first person will find the perimeter and area and explain how they got their answer.

5) Take turns until each person has made 5 rectangles.

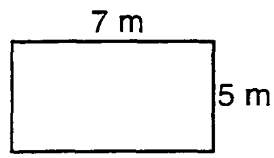
Name ____________________________
Date ____________________

Perimeter and Area of Rectangles

Find the perimeter and area of each rectangle. Write a formula and show your work.

EXAMPLE:

1.



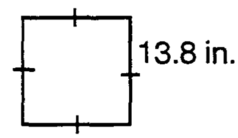
$P = 2\,(l + w)$ $\quad$ $A = lw$

$P = 2\,(7 + 5)$ $\quad$ $A = 7 \bullet 5$

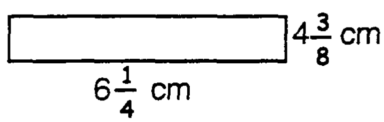
$P = 2 \bullet 12$ $\quad$ $A = 35$ sq. m.

$P = 24$ m.

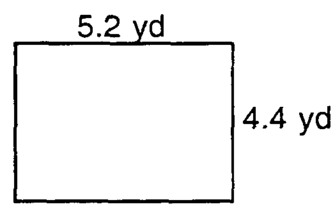
2.



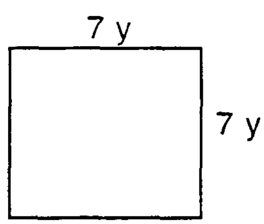
3.



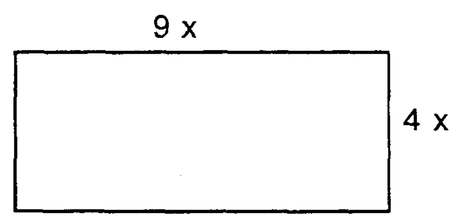
4.



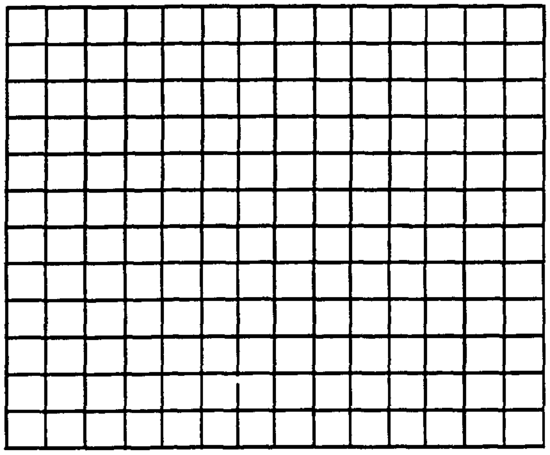
5.



6.

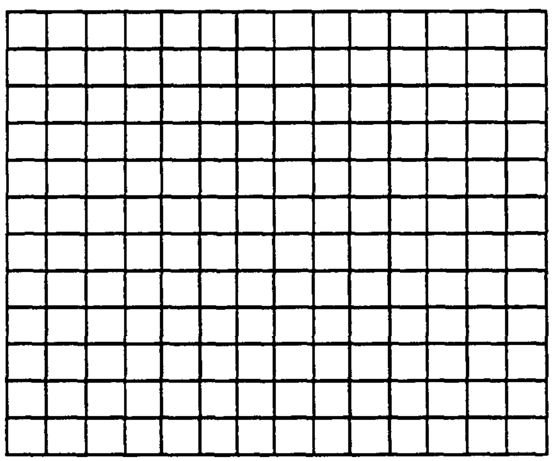


7. Draw four rectangles that fit the following descriptions and label them as A, B, C, and D:



- rectangle A has a perimeter of 12 units
- rectangle B has a perimeter of 8 units
- rectangle C has an area of 9 square units
- rectangle D has an area of 2 square units

8. Draw one rectangle with an **area** of 18 square units and a **perimeter** of 18 units.



Solve these problems. Show your work.

1. José keeps his horse in a rectangular field which is 88 yards wide and 100 yards long. Find the perimeter and the area of the field.

2. How much would José have to pay to buy a fence to go around the field if the fence costs $11.00 per yard? ___________

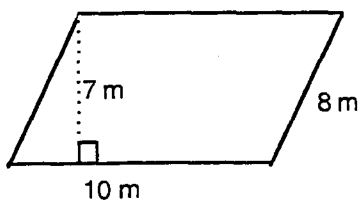
Name ____________________

Perimeter and Area of Parallelograms

Find the perimeter and area of each figure. **Write a formula and show your work.**

EXAMPLE:

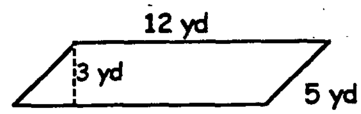
1.



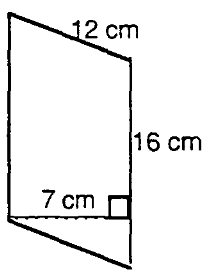
P = s + s + s + s
P = 8 + 10 + 8 + 10
P = 36 m

A = bh
A = (10)(7)
A = (70)
A = 70 sq m

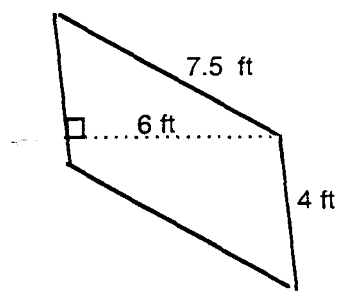
2.



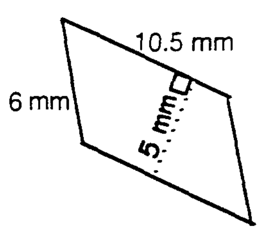
3.



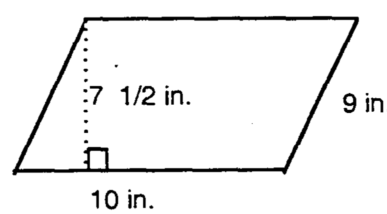
4.



5.



6.



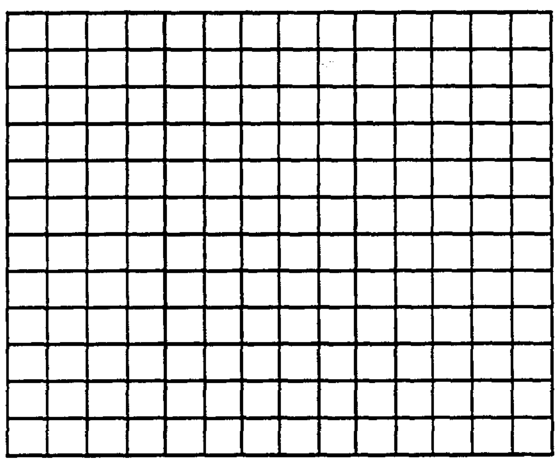
<u>Find the area of each parallelogram.</u> Draw and label the parallelogram. Show your work.

7. A parallelogram has a base of 8 m and height of 5 m.

8. A parallelogram has a base of 13 ft and height of 24 ft.

9. A parallelogram has a base of 2 1/2 ft and height of 1 1/3 ft.

<u>Draw a parallelogram with a base of 6 units and height of 8 units.</u> <u>Label the length of the bases and height.</u>



The area of the parallelogram drawn above is _______________.

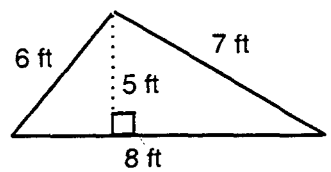
Name ____________________

Perimeter and Area of Triangles

<u>Find the perimeter and area of each figure.</u> Write a formula and show your work.

EXAMPLE:

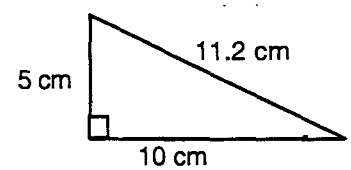
1.



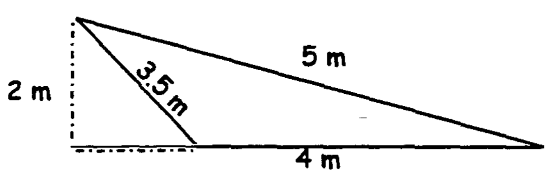
P = s + s + s
P = 8 + 7 + 6
P = 21 ft

A = 1/2 bh
A = 1/2 (8)(5)
A = 1/2 (40)
A = 20 sq ft

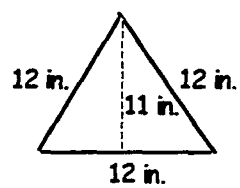
2.



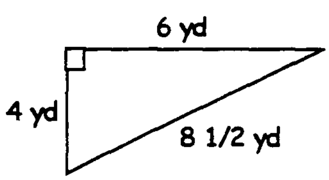
3.



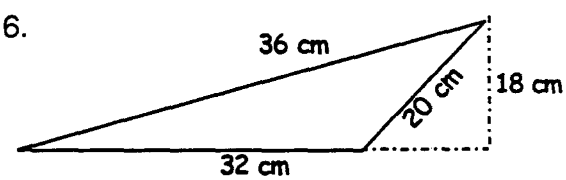
4.



5.



6.



Solve each problem to find the perimeter. Draw and label each figure. Show your work.

1. Two sides of an isosceles triangle measure 6.45 m each. The remaining side measures 9.74 m. What is the perimeter of the triangle? ____________________

2. The sides of an equilateral triangle measure 56 yards. What is the perimeter of the triangle? ____________________
   What kind of triangle is it? ____________________

3. A triangle has three sides which measure 26.5 meters, 22.2 meters, and 24.3 meters. What is the perimeter? _______________ What kind of triangle is it? __________

Solve each problem to find the area, base or height. Show your work.

1. The base of a triangle is 10 square feet and the height is 8 feet. What is the **area** of the triangle? ____________________

2. The area of a triangle is 12 square feet and the base is 4 feet. What is the **height**? ____

3. The area of a triangle is 32 square inches and the height is 8 inches. What is the measurement of the **base**? ____________

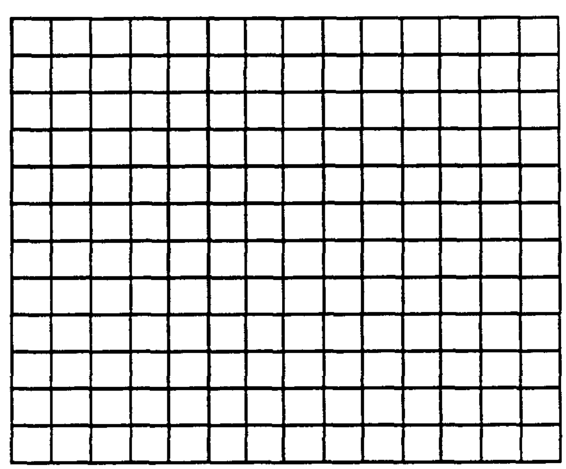
Draw on the grid paper provided.

Draw a right triangle with a base of 6 units and a height of 9 units.

Use a ruler to find the perimeter of the triangle in inches. ____________

Label the measurement of each side.

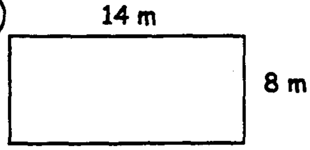
What is the area of the triangle?________



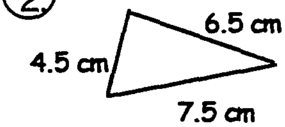
Name ________________

Perimeter of Polygons

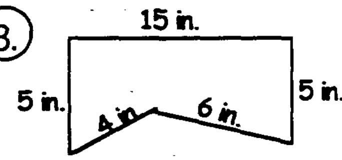
Find the perimeter of the polygons below.

1.


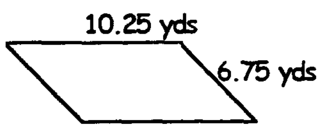
P =

2.


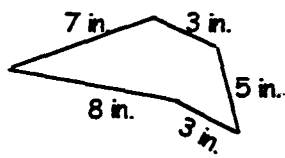
P =

3.


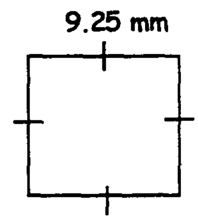
P =

4.


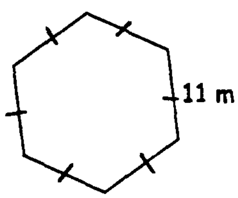
P =

5.


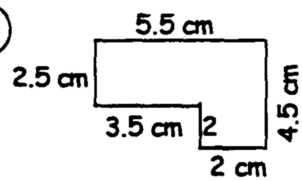
P =

6.


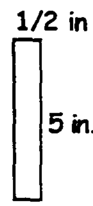
P =

7.


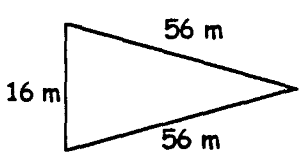
P =

8.


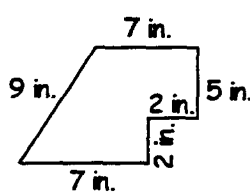
P =

9.


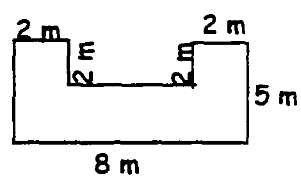
P =

10.


P =

11.


P =

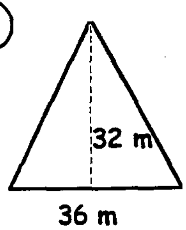
12.


P =

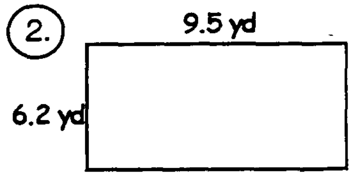
Name ________________

Area of Polygons

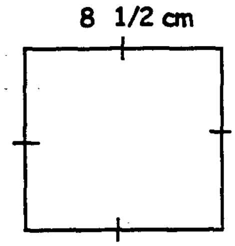
Find the area.

1. 

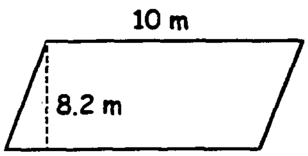
A =

2. 

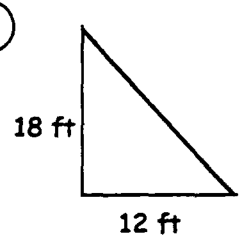
A =

3. 

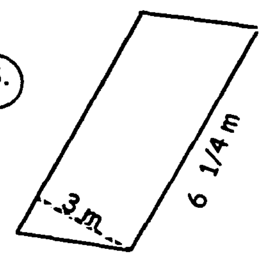
A =

4. 

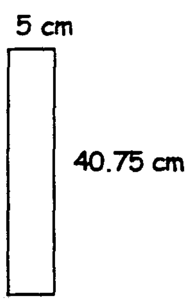
A =

5. 

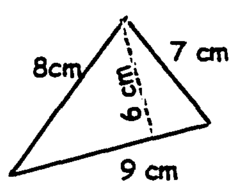
A =

6. 

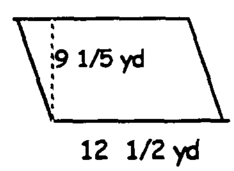
A =

7. 

A =

8. 

A =

9. 

A =

Name ______________

Vocabulary Practice
Perimeter and Area

Part I. Sentence completions. Use the vocabulary words in the box to complete the sentences below.

area	base	formula	height
length	perimeter	perpendicular	width

1. The distance around the outside of a figure is called the ____________________ .

2. ____________________ is the measurement of the square units inside a figure.

3. The ____________________ of a parallelogram is the top or bottom.

4. The base of a parallelogram is ____________________ to the height.

5. The ____________________ of a parallelogram is perpendicular to its bases.

6. ____________________ tells you how long something is.

7. The opposite of length is ____________________. It tells you how wide something is.

8. A ____________________ is like a recipe. It tells you how to find something such as the perimeter or area of a figure.

Part II. Free Response.

1. Think about something you don't understand about perimeter or area. Tell me about it. Write a few sentences or ask a question.

2. Tell me about something you really enjoyed learning about in this lesson. Tell me why you enjoyed this part.

Area & Perimeter Performance Task

You have just finished a class where you learned how to tile floors. Your family has asked you to help them tile their 8 ft X 12 ft kitchen floor. First determine the perimeter and area of the floor. Then decide what size tiles to buy: 4 in. X 4 in. or 6 in. X 6 in. or 12 in. X 12 in. Then determine the number of tiles you will need to buy.

Show your work.

Perimeter of floor ____________________

Area of floor ____________________

Size of tiles ____________________

Number of tiles ____________________

Explain in a few words how you got your answer. Write your idea step by step.

Answer Key
Obj. 50

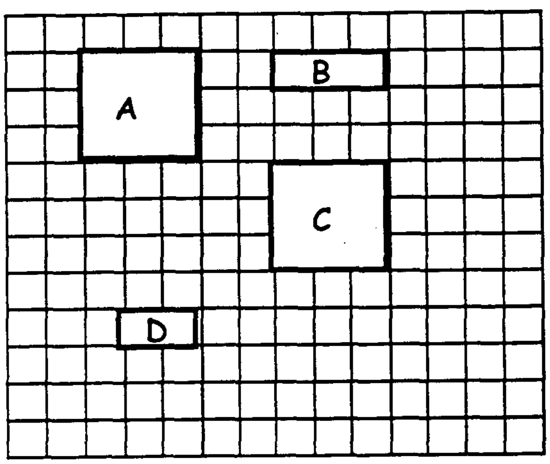
Perimeter of a Rectangle

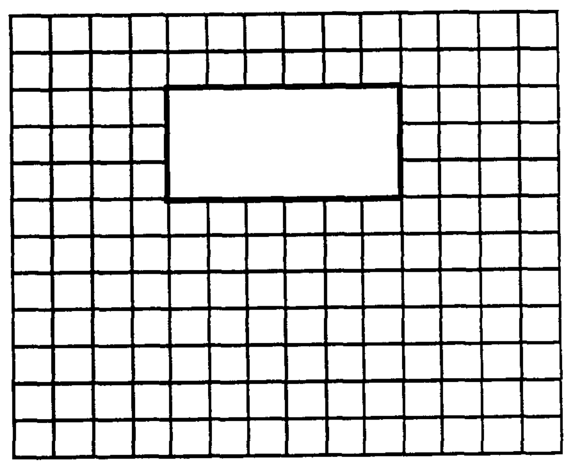
1. 26 ft 2. 42 m 3. 44 mm 4. 38 in. 5. 14 1/2 mm
6. 28.7 cm 7. 21 1/3 yd 8. 28 x 9. 40 xy 10. 10 in

Solve these problems.

1. 14 feet
2. No, she needs 14.4 inches.

Perimeter and Area of Rectangles

1. Example
2. P = 55.2 in A = 190.44 sq in
3. P = 21 1/4 cm
A = 27 11/32 sq cm
4. P = 19.2 yd
A = 22.88 sq yd
5. P = 28 y A= 49 y^2
6. P = 26 x A = 36 x^2
7. 

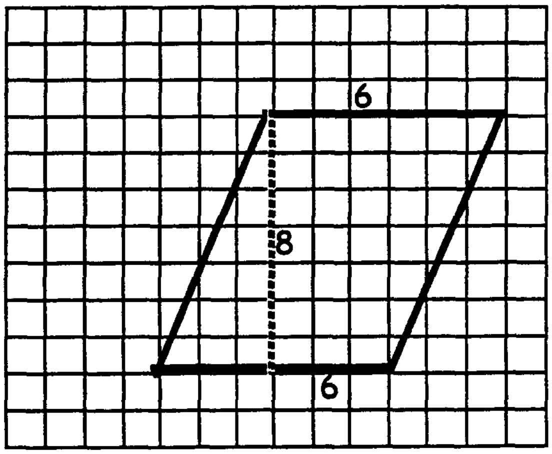
8. 

Solve these problems.

1. P = 376 yds
A = 8,800 sq yds
2. $ 4,136 (376 yd x $11)

Page 2 - Perimeter and Area of Parallelograms

1. Example
2. P = 34 yds A = 36 sq yds
3. P= 56 cm A = 112 sq cm
4. P = 23 ft A = 24 sq ft
5. P = 33 mm A = 52.5 sq mm
6. P = 38 in A = 75 sq in
7. A = 40 sq m
8. A = 312 sq ft
9. A = 3 1/3 sq ft



Area = 48 sq units

Perimeter and Area of Triangles

1. Example
2. P = 26.2 cm A = 25 sq cm
3. P = 12.5 m A = 4 sq. m
4. P = 36 in A = 66 sq in
5. P = 18 1/2 yd A = 12 sq yds
6. P = 88 cm A = 288 sq cm

Solve each problem ti find the perimeter.

1. P = 22.64 m
2. P = 168 yards
3. P = 73 meters; scalene triangle

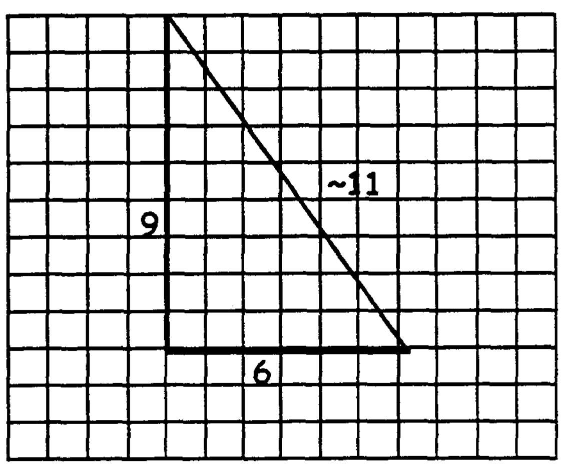
Solve each problem to find the area, base, or height.

1. A = 40 sq feet
2. H = 6 feet
3. B = 8 inches

Draw on the grid paper provided.

P = ~26 units

A = 27 sq units



Perimeter of Polygons

1.	P = 44 m	2.	P = 18.5 cm	3.	P = 35 in
4.	P = 34 yds	5.	P = 26 in	6.	P = 37 mm
7.	P = 66 m	8.	P = 20 cm	9.	P = 11 in
10.	P = 128 m	11.	P = 32 in	12.	P = 30 m

Area of Polygons

1.	A = 576 sq m	2.	A = 58.9 sq yd	3.	A = 72 1/4 sq cm
4.	A = 82 sq m	5.	A = 108 sq ft	6.	A = 18 3/4 sq m
7.	A = 203.75 sq cm	8.	A = 27 sq cm	9.	A = 115 sq yd

Vocabulary Practice - Perimeter and Area

Part I. 1. perimeter	2. area	3. base	4. perpendicular
5. height	6. length	7. width	8. formula

Part II. Answers will vary.

Area and Perimeter Performance Task

Perimeter of floor = 40 ft

Area of floor = 96 sq ft

Size of tiles = 4x4 6x6 9x9

HINT = First change feet to inches 8' x 12' = 96" x 144" so the area in inches = 13,824 sq in

4x4 tile = 16 sq in $16\overline{)13824}$ = 864 tiles

6x6 tile = 36 sq in $36\overline{)13824}$ = 384 tiles

12x12 tile = 144 sq in $144\overline{)13824}$ = 96 tiles

Objective 51: Investigate circles:

- **relationship of diameter to radius and circumference**
- **concept of Pi (π)**
- **use of formulas to find circumference ($C = \pi d$)**
- **area ($A = \pi r^2$)**

Vocabulary

circumference
radius
diameter
chord
pi (π)

Language Foundation

1. Review circle vocabulary previously introduced in Objective 47.

Materials

variety of circular objects
string
rulers (with centimeters)
calculators, optional
grid paper (found in Obj 50)
colored pencils

Transparencies

- <u>Investigating Circles Spreadsheet</u>
- <u>Area of a Circle</u>
- <u>Finding the Formula for Area of a Circle</u>

Student Copies

- <u>Investigating Circles</u>
- <u>Computer Spreadsheet Directions,</u> optional
- <u>Circumference of Circles</u>
- <u>Area of a Circle</u>
- <u>Area of Circles Activity Sheet</u>
- <u>Vocabulary Practice - Circles</u>

Mathematics Component

__Circumference and Radius of a Circle__

1. Review basic circle vocabulary which has been previously introduced:
   - **circumference** (the outside edge or perimeter of a circle)
   - **diameter** (line segment that goes through the center point of a circle)
   - **radius** (line segment from the center to any point on the perimeter of the circle)
   - **chord** (line segment joining any two points on a circle)

2. Measure the diameter and circumference of a variety of circles.
   - Divide students into groups of four students.
   - Give each group 3 different objects with circular faces. Use items with a variety of diameters (i.e. bottom of trash can, rolls of tape, cups, cans). Each group will also need approximately 1 yard of string, a ruler, and an __Investigating Circles__ activity sheet.
   - Have each group record the names of their objects on the activity sheet.
   - Groups should then measure the **circumference** of each circle. Tell groups to:
     1) lay one end of the string on the outside edge of the item and wrap the string around the entire perimeter;
     2) mark the end where the string meets;
     3) measure the length of the marked piece of string using a __centimeter__ ruler, and record.
   - Have groups use the string and rulers to measure and record the **diameter** of each circle in centimeters.
   - Collect all of the data from each group and record on a transparency copy of __Investigating Circles__.

   NOTE: The collected data can be recorded on a computer spreadsheet and projected on a large screen monitor, if available. See __ClarisWorks Computer Spreadsheet Directions__ for set-up and instructions.

3. Analyze the data.
   - Ask students if they see any relationship between the circumference and the diameter of the items on the __Investigating Circles__ transparency. Give students a few minutes to look at the data. If they do not see a relationship ask, "The **circumference** is about how many times the **diameter**?" (__About__ 3.) Have a student come up and use the data to explain their reasoning.
   - Say, "Do you think the circumference will be about 3 times the diameter for __ALL__ circles?" (Yes, the circumference is __about__ 3 times the diameter no matter what the size of the circle.)
   - Draw a circle on the board and mark the diameter as 6 inches. Ask, " Can we estimate the **circumference** of this circle if the diameter is 6 inches?" (The circumference would be about 18 inches.)

- Ask, " How could you find the **circumference** of a circle with a **diameter** of 3 feet?" (Circumference would be 3 x 3 or 9 feet.) What would the circumference be if the **radius** of the circle is 2 feet? BE CAREFUL! This one is tricky!" (You would need to double the radius to get a diameter of 4 feet and then multiply by three to get a circumference of about 12 feet.)
- Lead students to the conclusion that the circumference of a circle will always be about three times larger than the diameter.

4. Introduce Pi (π)
   - Record the ratio of **circumference/diameter** for each item on the Investigating Circles transparency. (For example circumference to diameter for one item might be written as 1 1/3.)
   - Have students use calculators to convert each ratio to decimal form by dividing the numerator by the denominator. Record answers on the transparency.
   - Ask, "What do you notice about the decimal values of the ratios?" (All of the values are a little more than 3.)
   - Tell students that this ratio of the circumference to the diameter of a circle is called **Pi.**
   - Explain that a famous Greek mathematician named Archimedes discovered that all circles have this ratio.
   - Tell students we can use an improper fraction (**22/7**) or a decimal form (**3.14**) to represent Pi.

5. Working with the formula for circumference of a circle.
   - Have students use a calculator to multiply π • diameter for the first item on the transparency.
   - Compare students' answers with the circumference shown for that item.
   - Introduce the formula Circumference = Pi • diameter,or $\mathbf{C = \pi d}$. Ask students if we could use the radius instead of the diameter in the formula? (Yes, but we would have to multiply the radius times 2 so that it would be the same as the diameter.) The formula using radius would be $\mathbf{C = \pi 2 r}$ or $\mathbf{C = 2 \pi r}$. (Order does not matter because it is multiplication.)
   - Distribute calculators and student copies of the activity sheet Circumference of Circles. Using a transparency copy of the activity sheet, work problems together as a class reviewing concepts and academic language.

Area of a Circle

1. Investigate the area of a circle. (Distribute grid paper (in Obj. 50) to each student.)
   - Use a compass to draw a circle on your transparency grid paper with approximately a 5 cm radius.
   - Have students do the same on their grid paper.
   - Ask students to estimate the area of the circle using square units on the grid paper. Remind students that they will have to deal with the partial squares.
   - Ask students if they think this is a good strategy for finding the area of a circle. (No, because it is not very accurate.)
   - Tell students that they will learn a different method to find the area of a circle.

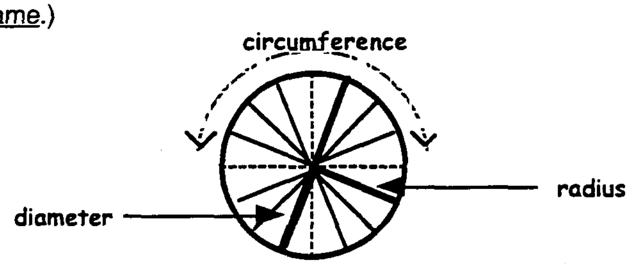
2. Pass out student copies of the activity sheet Area of a Circle.

- Using a transparency copy of the activity sheet, review the following parts of a circle:

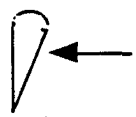
  circumference - distance around the outside of the circle

  diameter - distance across the circle, passing through the center point (Be sure to point out that there are many paths across the circle which pass through the center. Each one is a diameter and measures the same.)

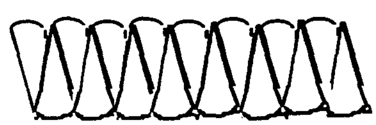
  radius - distance from the center to the outside of the circle. (There are many paths from the center of the circle to the outside. Each is a radius and measures the same.)



- Have students color each half of the circle a different color and then cut around the outside of the circle. Then have them cut the circle into 16 pieces by cutting along the dotted lines. (Do the same with the transparency copy.)

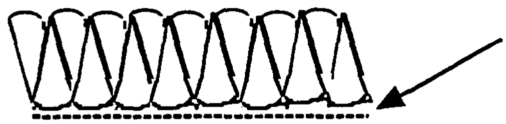


- Ask students if the 16 pieces when put together would have the same **area** as the original circle? Why? (They would have the same area because they cover the same amount of space as the original circle. We have just cut the circle into pieces.)
- Using the transparency pieces, model lining the pieces up to form a **parallelogram** as shown below. (Half of the wedges point up and half of the wedges point down.)



- Review the formula for the area of a parallelogram. (A = base • height or A = bh)
- Explain that since the area of the parallelogram and the circle are the same, we can use the formula for area of a parallelogram to help us find the formula for the area of a circle.
- Ask students if they can tell you anything about the circle by looking at the **base** of this parallelogram.

  (The base is the same as 1/2 of the circumference of the circle since it is the outside edges of 8 of the pieces.)



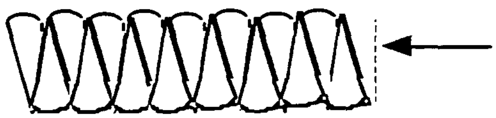
This distance is the same as half of the circumference since it is the outside edges of 8 out of 16 of the pieces.

- The parallelogram formula for area is A = bh. We have shown that $\frac{1}{2}$ C is the same as the **base** of the parallelogram. So for the **circle**, we can <u>substitute</u> 1/2 C in place of the base in the formula.

$$\text{(Parallelogram)} \quad A = \cancel{b} \; h$$

$$\text{(Circle)} \quad A = \frac{1}{2} C \, h$$

- Ask students to look back at the height of the parallelogram. Say "What can you tell me about the circle by looking at the **height** of the parallelogram. (The height is the same as the radius of the circle.)



The height of the parallelogram is the same as the radius of the circle since it is a segment from the center to an outside point.

- Show students that we can substitute radius for the height in the final formula for area of the parallelogram:

$$\text{(Parallelogram)} \quad A = \cancel{b} \quad \cancel{h}$$

$$\text{(Circle)} \quad A = \frac{1}{2} C \bullet r$$

- Tell students that we have used the formula for area of a parallelogram to help us find the formula for area of a circle. The area of a parallelogram is base times height and the formula for a circle is A = 1/2 C • r .
- Explain that there is a also a shorter way that we can write the same formula. Ask students to think back to the formula for **circumference** of a circle.

Since $C = 2\pi r$,

$$A = \frac{1}{2} \bullet C \bullet r$$

$$= \frac{1}{2} \bullet 2\pi r \bullet r$$

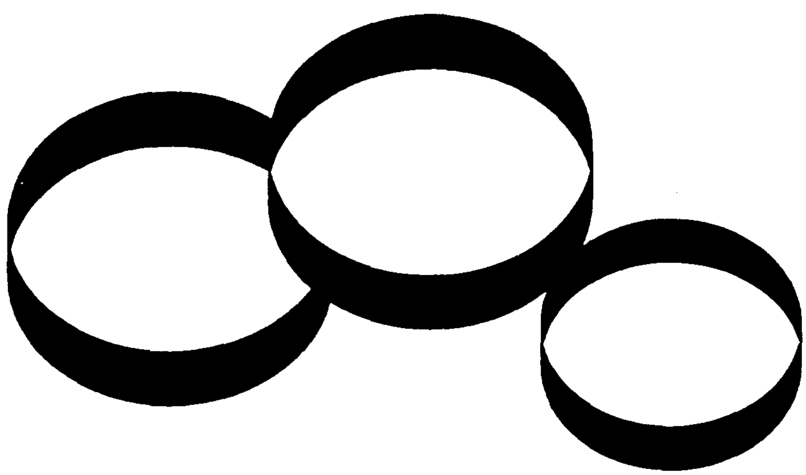
$$= \pi r^2$$

- Use the transparency Finding the Formula for Area of a Circle to review the steps above.
- Use the activity sheet Practice With Area of Circles to model several examples of using the formula to find the area of a circle. Pay special attention to examples where the diameter is given. Remind students that the diameter will have to be cut in half first.

Student Group Copy

Investigating Circles

Object	Circumference	Diameter



Investigating Circles

OBJECT	Circumference	Diameter	Ratio C/d	Decimal

ClarisWorks Computer Spreadsheet Directions

1. Set up Spreadsheet.
   - Open a new spreadsheet.
   - In cell **A1** type **object**; then press tab.
   - In cell **B1** type **circumference**; press tab.
   - In cell **C1** type **diameter**; press tab.
   - In cell **D1** type **Ratio c/d**; press return.
   - Click and drag highlighting from **A1** over and down to **D11**; release.
   - Click on **Format** and drag down to **Row Height**; release.
   - Change Row Height to 25; click ok.

2. Collect data.
   - Enter information from groups in appropriate cells in column A, B and C.

3. Set up formula to calculate ratio of circumference to diameter.
   - Click in cell **D2**.
   - Type: **=B2/C2**; press return.
   - Click on cell **D2** and drag down highlighting to cell **D 11**; release.
   - Hold down the open apple key (next to space bar) and the D key. You can also choose **Calculate** from the menu and scroll down to **Fill Down**. This command will calculate the ratio.

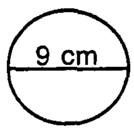
Name: ____________________

Circumference of Circles

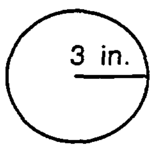
Formula: ______________

π = ________

Find the circumference. Use 3.14 for π
Round to the nearest whole number.

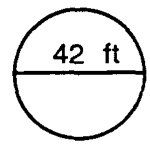
1) 

C = ___ x ___

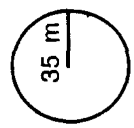
2) 

C = ___ x ___

Find the circumference. Use $3\frac{1}{7}$ or $\frac{22}{7}$ for π

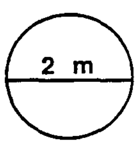
3) 

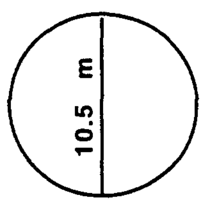
C = ___ x ___

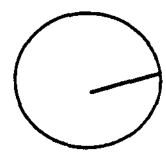
4) 

C = ___ x ___

Find the circumference of the circles.
Use the formula and show your work. (Round to the nearest tenth)

1) 

2) 

3) 

4) radius = 3.2 m

5) radius = 23 yds

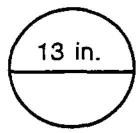
6) diameter = 14 ft

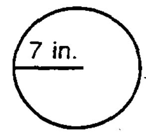
Circumference of Circles

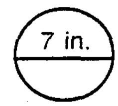
Which figure has the same circumference as the one given?

Circumference

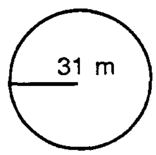
1) 44 in.

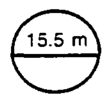


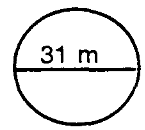




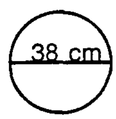
2) 97 m

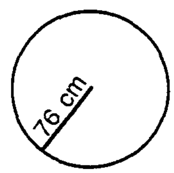


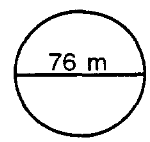




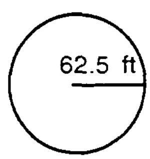
3) 239 cm

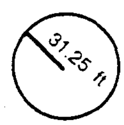


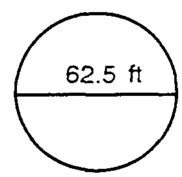




4) 393 ft





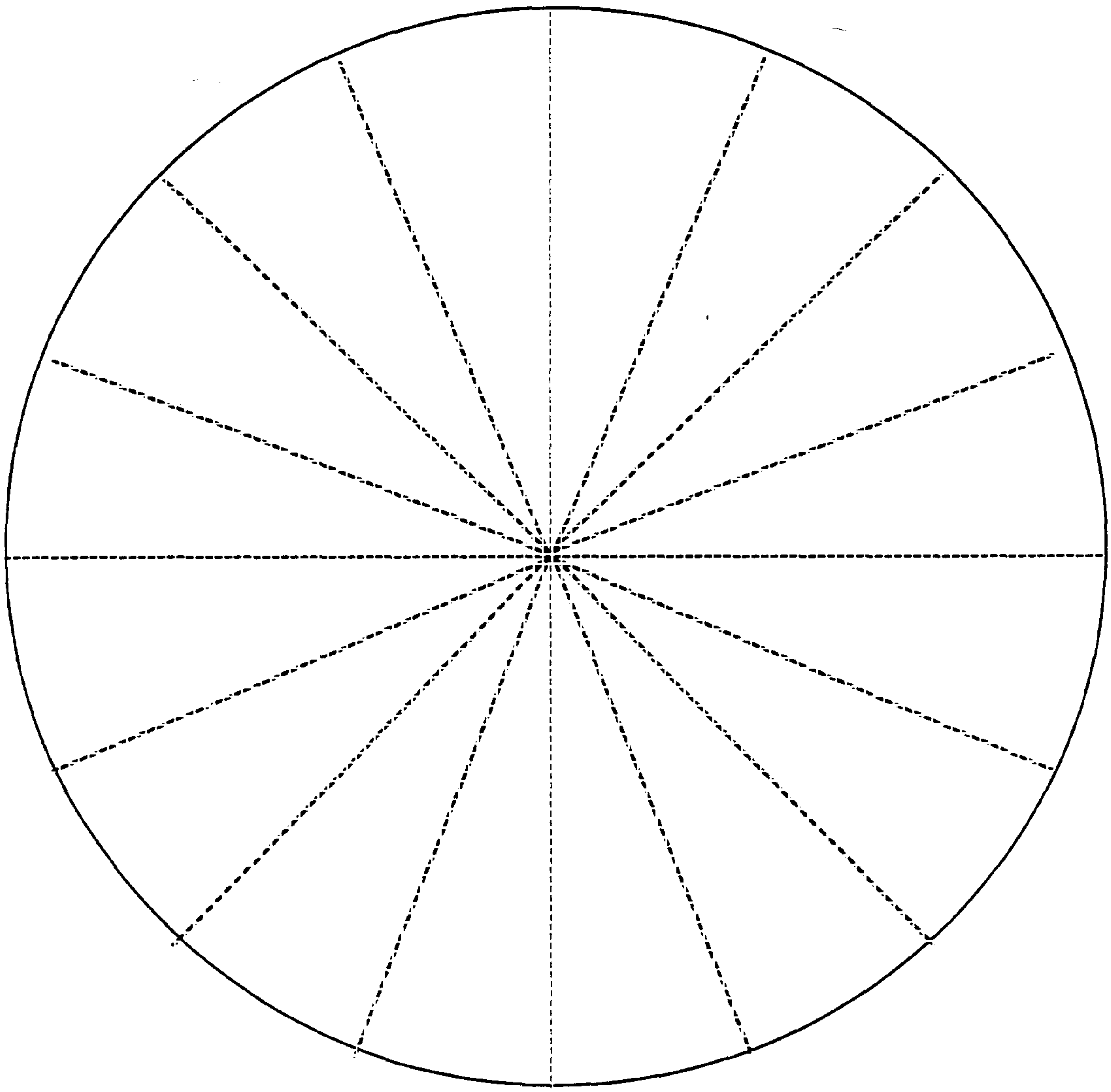


Solve these problems. Draw and label a picture. Use a formula and show your work.

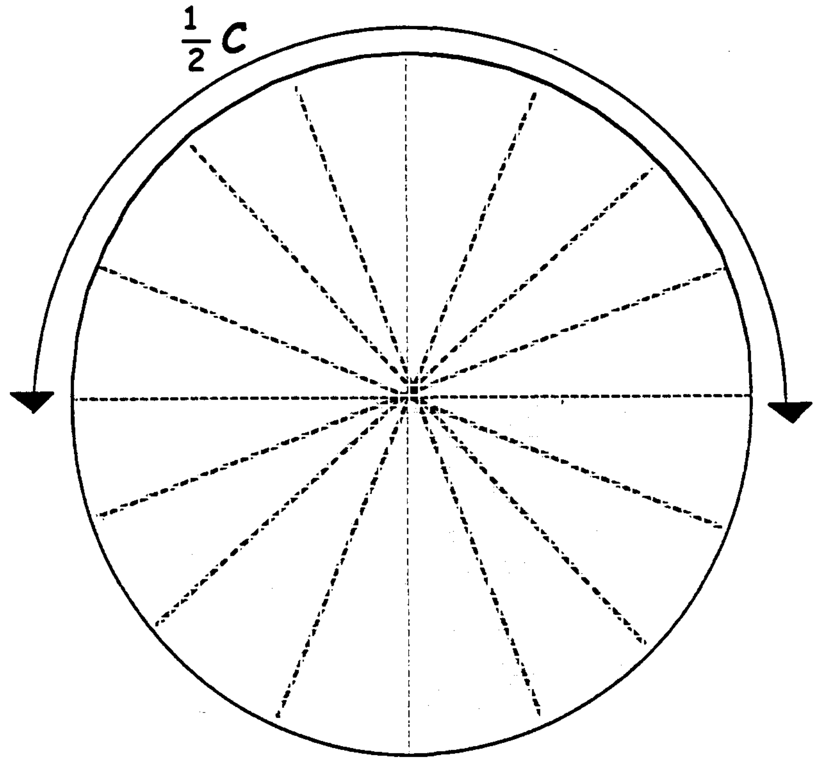
Dianna is eating an ice cream cone. What is the circumference of her cone if the diameter is $2\frac{1}{3}$ inches?

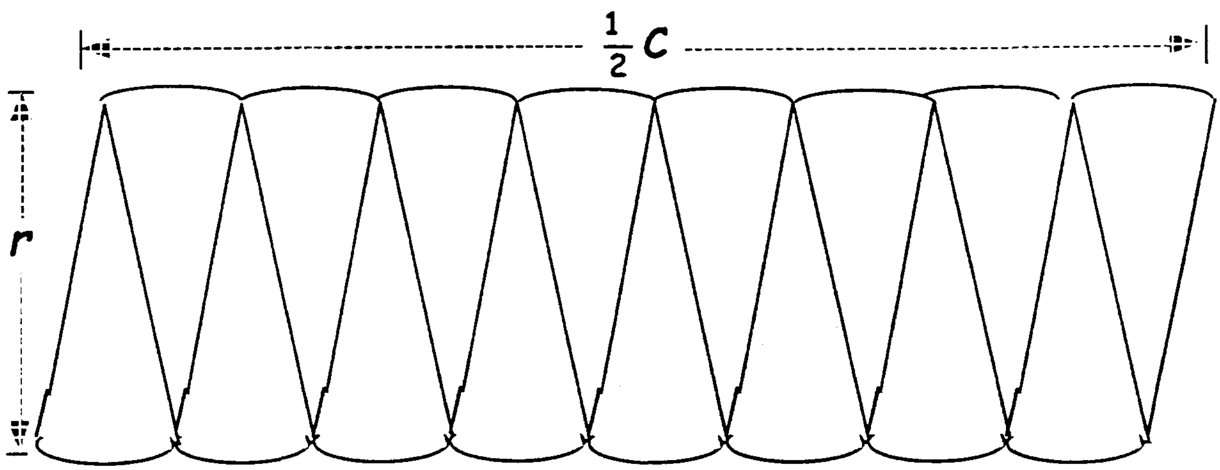
The radius of the rim of the basketball net is 9 in. What is the circumference?

Area of a Circle



Finding the Formula for Area of a Circle





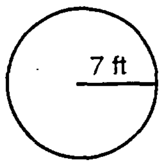
Name: ________________

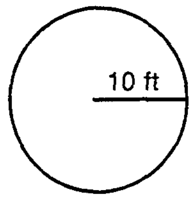
Area of Circles

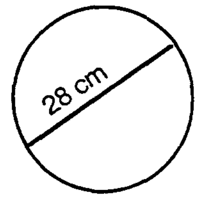
Formula ____________

π = ______ **or** ______

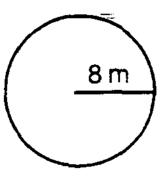
Find the area. Use the formula and show your work. Use $\frac{22}{7}$ for π.

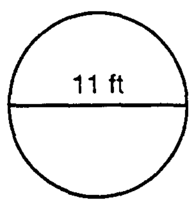
1) 

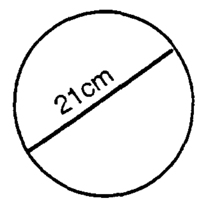
2) 

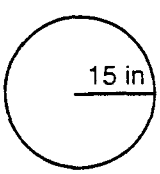
3) 

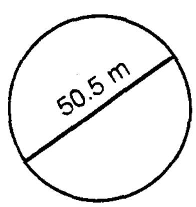
Find the area. Use the formula and show your work. Use 3.14 for π.
(Round to the nearest tenth.)

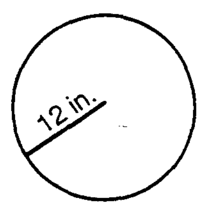
4) 

5) 

6) 

7) 

8) 

9) 

Area of Circles

• Find the area when the radius is given. Use the formula and show your work.
(Round to the nearest whole number.)

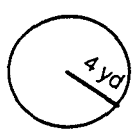
1) r = 5 in   2) r = 20 yds   3) r = 100 m

• Find the area when the diameter is given. Use the formula and show your work.
(Round to the nearest whole number.)

1) d = 30.5 ft   2) d = 48 yds   3) d = 100.6 cm

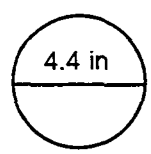
• True or False? Show your work to prove your answer.

1)



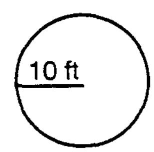
$A = 50.2\ yd^2$

2)



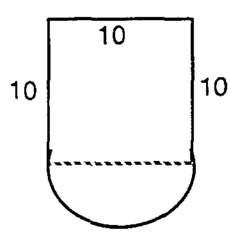
$A = 15.2\ in^2$

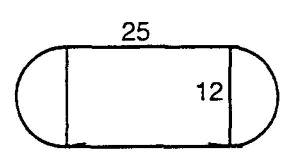
3)



$A = 31.4\ ft^2$

• Find the area of these figures. Round to the nearest whole number.





Name___________________

Vocabulary Practice - Circles

Part I. Sentence Completions. Use the vocabulary words in the box to complete the sentences below.

circumference	diameter	chord
pi	perimeter	radius

1. ___________________ is the distance around a figure.
2. The distance around a circle is the ___________________.
3. ___________________ is the ratio of the circumference of a circle to its diameter. Its value is approximately 3.14.
4. A line segment that joins any 2 points on a circle is called a ___________________.
5. The ___________________ of a circle is a chord that goes through the center of the circle.
6. A line segment that goes from the center of the circle to a point on the perimeter of the circle is its ___________________.

Part II. Analogies. Complete each comparison. Make sure that the relationship between the second pair is the same relationship shown by the first pair.

1. three : one	as	circumference : ______________
2. polygon : perimeter	as	circle : ___________________
3. two : one	as	___________________ : radius
4. diameter : radius	as	one : ___________________

Part III. Diagram. Draw a circle below. **Draw lines** to represent a chord, the diameter, and the radius. **Label** your diagram.

Answer Key
Obj. 51

Circumference of Circles

Formula: $C = \pi d$

$\pi = 3.14$ or $22/7$

1. 28 cm
2. 19 in.
3. 132 ft
4. 220 m

Which figure has the same circumference?

1. #2 - 7" radius C=43.96
2. #3 -32m diameter C=97.34
3. #3 - 76 m diameter C= 238.6
4. #1 -62.5radius C=392.5

Find the circumference of the circles

1. 6.3 m
2. 33.0 m
3. 25.1 cm
4. 20.1 m
5. 144.4 yds
6. 44.0 ft

Solve these problems:

1. Ice cream cone C = 22/7 x 2 1/3 C = 7 1/3 in
2. Basketball rim C= 3.14 x 18 C= 56.52 in

Area of Circles

1) 54 ft^2
2) 314.3 ft^2
3) 616 cm^2
4) 201 m2
5) 95 ft^2
6) 346.2 cm^2
7) 706.5 in^2
8) 79.3 m^2
9) 452.2 in^2

Find the area when the radius is given.

1) 79 in^2
2) 1,256 yd^2
3) 31,400 m^2

Find the area when the diameter is given.

1) 730 ft^2
2) 1809 yds^2
3) 7,944 cm^2

True or False

1) True
2) True
3) False - 314 ft^2

Find the area of these figures.

1) square = 100 semicircle = 39.2 Total = 139
2) rectangle = 300 circle = 113.04 Total = 413

Vocabulary Practice

1) Perimeter
2) Circumference
3) Pi
4) Chord
5) Diameter
6) Radius

Analogies

1) diameter
2) circumference
3) diameter
4) one-half

Objective 52: Identify, name, and define the characteristics of space figures, including cones, prisms, pyramids, and cylinders.

Vocabulary

space figure
face
edge
vertex, vertices
polyhedron
prism
triangular prism
rectangular prism
pentagonal prism
hexagonal prism
octagonal prism
pyramid
rectangular pyramid
triangular pyramid
cylinder
cone
sphere

Materials

solid space figures

Transparencies

- Parts of a Space Figure
- Polyhedrons
- Prisms
- Space Figures - (Solids) wall poster

Student Copies

- Faces, Edges, and Vertices
- Prisms
- Prism or Pyramid?
- Practice with Polyhedrons
- The Great Pyramid

Language Foundation

1. Tell students that they will learn about space figures in this lesson. Talk about the word space and brainstorm with students different meanings of the word. Talk about space as in outer space. Then turn the discussion to space in the classroom. Ask students to look around the room at objects that fill up the space in the room. Have students look at the desks and ask if there is room for more desks. Explain to students that if we added more desks, these desks would "take up" the space left in the room. Continue the discussion about space in the room to help students understand the concept of "taking up space."

2. Another example of a word with more than one meaning is the word **face**. As a noun, it can mean the front of our head, or as a verb, to look directly at someone or something. Tell students that the word **face** has a different meaning in math which they will learn in this lesson.

3. Review the following numerical prefixes with students:

   - **octa** = eight
   - **hexa** = six
   - **penta, pent** = five
   - **tri** = three

4. For background information about pyramids, use the extension page The Great Pyramid.

Mathematics Component

1. Define space figure and basic vocabulary associated with space figures.
   - Using a set of solids, hold up a rectangular prism.
   - Ask students to describe what they see. (Possible answers: box, four-sided figure)
   - Explain that this figure and others can be called **space figures**. Space figures are three-dimensional figures. Three-dimensional means that a figure has length, width, and height and, therefore, takes up space.
   - Ask students to look around the room and identify other **space figures**. (Cans, boxes. etc.)
   - Explain that space figures have special characteristics. Hold up the cube and say, "Some space figures like this one have flat surfaces. A flat surface on a space figure is called a **face**."
   - Use the <u>Parts of a Space Figure</u> transparency to review the definition of **face** and to introduce the terms **edge** and **vertex**.
   - Choose other solid figures such as a rectangular prism, a triangular prism, and a rectangular pyramid. Allow students to touch and count the number of flat surfaces on each. Remind students that these are called **faces**.
   - Model running your finger across places where two faces intersect on the solids and allow students to do the same. Remind students these are called **edges**. Have students identify and count the edges on several space figures.
   - Point out a place on one solid where the edges of the space figure intersect. Remind students that this is called a **vertex**. Have students identify and count the number of vertices on other space figures. Point out the difference in the singular and plural words: singular is **vertex** and plural is **vertices**. Model as you say, "This is a <u>vertex</u>. This space figure has 8 <u>vertices</u>."
   - The activity sheet <u>Faces, Edges, and Vertices</u> will give students additional practice identifying and counting these parts of a space figure.

2. Explore characteristics of polyhedrons as space figures.
   - Hold up a prism or a pyramid from a set of solids.
   - Tell students that some space figures like this one have <u>only</u> flat surfaces, or **faces**. A space figure with only flat surfaces or faces is called a **polyhedron**.
   - Hold up several different solids and ask students, "Is this a polyhedron? Why?" Be sure to include a few solids which do not have <u>only</u> flat surfaces (cylinder, cone, etc.) so that students make the connection that a figure is a polyhedron only if it has faces which are all flat surfaces.
   - Use the <u>Polyhedrons</u> transparency to reinforce the concept of space figures which have only flat surfaces.
   - Have students review what a space figure is and talk about the difference between polyhedrons and figures which are not polyhedrons. Begin the following tree diagram on a clean transparency.

Space Figures

polyhedrons **not polyhedrons**

- Tell students that polyhedrons are identified by the number and shape of their bases. If the polyhedron has two congruent bases it is called a **prism**. Review congruent, if necessary.
- Add prisms to the diagram as shown below. Remind students that this is only one kind of polyhedron. Prisms have two congruent bases. (Save the diagram to use later.)

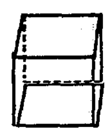
Space Figures

polyhedrons **not polyhedrons**

prisms

- Show students a triangular prism. Pass the solid around and ask students why they think it is called a **triangular prism**. Lead them to understand that it is named by its two congruent triangular bases.

- Show students a rectangular prism. Pass this solid around and ask students why they think it is called a **rectangular prism**. Lead them to understand that it is named by its two congruent rectangular bases.



- Ask students what they think a **pentagonal prism** would look like. (It would have two congruent pentagonal bases.)
- Distribute student copies of the chart Prisms. Place a transparency copy on the overhead. Identify the shape and number of sides on each base for each of the prisms. Record this information in the appropriate columns on the chart. You may need to review the names of six- and eight-sided polygons as you introduce the **hexagonal prism** and the **octagonal prism**.
- Ask students to look at their charts with a partner to see if they can find anything that is the same about all of the prisms. List responses such as the faces are polygons or they each have two bases. Lead them to see that the faces which are not the bases are all rectangular.
- Point to the column labeled "Number of Faces Which are Not Bases." Ask students how we can find the number of faces which are not bases. Lead them to understand that this number is the same as the number of sides on the polygon bases. For example, a triangular prism has polygon bases with three sides; therefore, it has three faces which are not bases. The rectangular prism has polygon bases with four sides; therefore, it has four faces which are not bases. Record the information for each of the prisms in the appropriate column. (See the Answer Key for a completed chart.)

- Go back to the tree diagram started earlier on a transparency to show the different branches of space figures.
- Tell students that a polyhedron with only <u>one</u> base also has a special name. It is called a **pyramid**. Add pyramids to the diagram as shown below. (Save the tree diagram for use in activity three.)

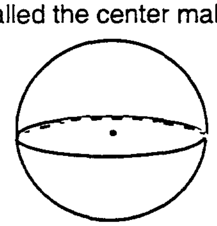
Space Figures

polyhedrons **not polyhedrons**

prisms **pyramids**

- Show a **rectangular pyramid** from a set of solids. Illustrate that it has only one base. Ask students why they think it is called a rectangular pyramid. (The base is a rectangle.) Ask students how many faces they think it will have which are not bases. (Four because the base is a rectangle.)
- Repeat the same procedure for a **triangular pyramid**, leading students to see that it has one triangular base and three faces which are not a base.
- Ask students what type of base and other faces they think a pentagonal or hexagonal pyramid would have. (A pentagonal pyramid would have a pentagon base and five other faces. A hexagonal pyramid would have a hexagon base and six other faces.)
- The activity sheet <u>Prism or Pyramid</u> is provided for student practice.

3. Investigate space figures which are not polyhedrons.
   - Review the tree diagram done in activity two above.
   - Point on the transparency diagram to the words "not polyhedrons." Tell students that there are three space figures which are not polyhedrons.
   - Hold up a cylinder from a set of solids. Say, "This is called a **cylinder**. A cylinder has two circular bases that are congruent and parallel." Have students suggest examples of a cylinder around the room or from everyday life.
   - Ask students what polyhedron the cylinder reminds them of and why. (It is similar to a prism with two congruent bases.)
   - Hold up a cone from a set of solids. Say, "This is a **cone**. A cone has one circular base and a vertex." Have students find examples of a cone around the room or from real life.
   - Ask students what polyhedron the cone reminds them of. (It is similar to a pyramid with only one base.)
   - Repeat the same procedure for a **sphere**. Lead students to understand that a sphere is not similar to any of the polyhedrons. It has no bases, other faces, or vertices. All of the points in space that are the same distance from a point called the center make up a sphere. Illustrate the center point by drawing the following sphere.



- The activity sheet Practice with Polyhedrons can be assigned for more practice with the topics covered in this lesson.
- A transparency/wall poster, Space Figures, is provided for review and reinforcement. Space Figures may be posted on a wall in the classroom or given to students to keep in their notebooks as a reference.

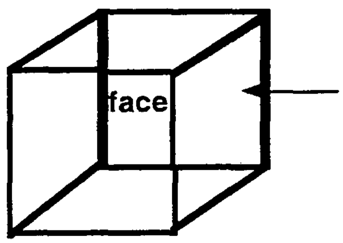
Language Development Activities

- The extension activity pages, The Great Pyramid, are provided to give students practice reading about historical math topics.

Parts of a Space Figure

A **space figure** is a three-dimensional figure which takes up space. A **polyhedron** is a special kind of space figure which has <u>only</u> flat surfaces.

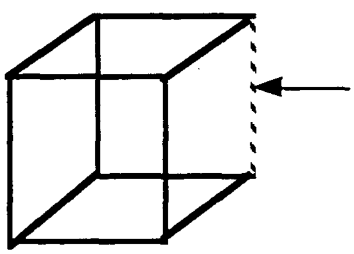
face



face - flat surface of a space figure

This space figure has 6 **faces.**

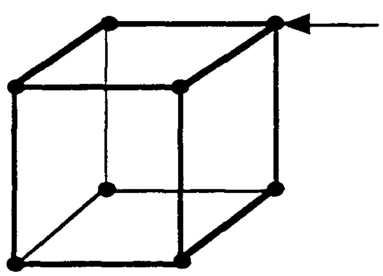
edge



edge - a line segment where two faces intersect on a space figure

This space figure has 12 **edges.**

vertex



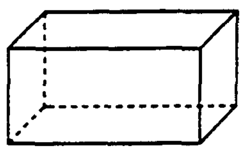
vertex - a point where the edges of a space figure intersect

This space figure has 8 **vertices.**

Name ____________________

Faces, Edges, and Vertices

Write the number of faces, edges, and vertices.

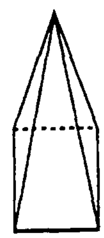


Rectangular Prism

faces ______

edges ______

vertices ______

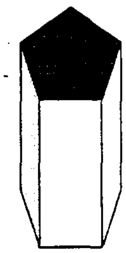


Rectangular Pyramid

faces ______

edges ______

vertices ______

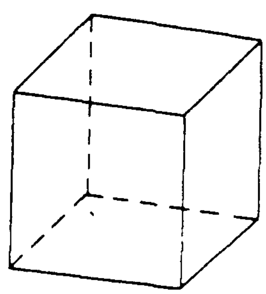


Pentagonal Prism

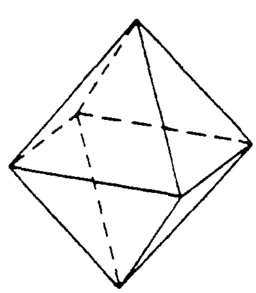
faces ______

edges ______

vertices ______



A cube has ______ faces, ______ edges, and ________ vertices. All the faces of a cube are in the shape of a __________.

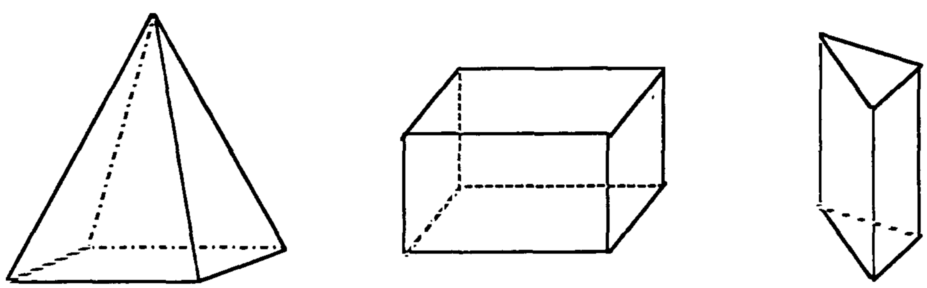


An octahedron has ______ faces, ______ edges, and ________ vertices. All the faces of an octahedron are in the shape of a __________.

Polyhedrons

A polyhedron is a space figure whose faces are all polygons.

These are all polyhedrons.



Space figures that have curved surfaces are <u>not</u> polyhedrons.

These are <u>not</u> polyhedrons.